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ANNALS

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CULEX (MELANOCONION) MULRENNANI, A NEW SPECIES FROM FLORIDA[1]

(Diptera: Culicidae)

ERNESTINE H. BASHAM,[2]
Florida State Board of Health

Eight species of *Culex*, subgenus *Melanoconion* are listed by Wirth (1945) as occurring in the United States, of which six have been recorded from Florida: *Culex pilosus* (D. &K.), *C. erraticus* (D. & K.), *C. peccator* D. & K., *C. atratus* Theob., *C. opisthopus* Komp, and *C. elevator* D. & K. *C. abominator* D. & K. has been recorded from Texas by King and Bradley (1937) with a later description of the larva by Eads (1943) and *C. anips* Dyar has been reported as collected in 1916 at San Diego, California by Dyar. Pritchard, et al. (1947) record four of the Florida species as occurring on the Florida Keys: *Culex atratus* Theob., *C. pilosus* (D. & K.), *C. elevator* D. & K., and *C. erraticus* (D. & K.), of which *C. atratus* Theob. is the most common species.

The present paper describes a new species of *Culex*, subgenus *Melanoconion* which was found breeding in the Florida Keys and presents brief notes on its biology and breeding habits. The species has been named *mulrennani*, in honor of Mr. John A. Mulrennan, Director, Division of Entomology, Florida State Board of Health.

BIOLOGY

On October 13, 1945, E. L. Seabrook and A. E. Pritchard collected seven male specimens of *Culex*, subgenus *Melanoconion* sp. at Big Pine Key, Monroe County, Florida, from limestone solution holes. On examination of the terminalia of the species, Dr. Alan Stone and Col. W. H. W. Komp determined it as undescribed. The occurrence of this species was noted by Pritchard, et al. (1947).

Surveys of the distribution and density of the mosquitoes of the Upper and Lower Florida Keys were made at intervals from October, 1945, through July, 1947; however, it was not until April 16, 1947, that additional specimens of this new mosquito were found, when Fred

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Miller collected four pupae and reared one male from a collection made on Ramrod Key, Monroe County, Florida, from a man-made well. The well, constructed in Miami oölitic limestone, measured three feet square by three feet deep, was located in direct sunlight fifteen feet from an abandoned chicken house, absolutely devoid of all vegetation, with a water depth of approximately seven inches. Associated reared specimens were two males *C. atratus* Theob. and one female *C.* (*Melanoconion*) sp.

From the same station on April 19, 1947, Fred Miller collected two pupae and the author reared one male *C. mulrennani*; the second pupae failed to emerge.

On July 24–30, 1947, a survey was made by D. C. Thurman, Jr. and the author during which time the Ramrod Key well failed to show evidence of any mosquito breeding.

On Big Pine Key, during this same survey, larvae of *C. mulrennani* were found to be breeding in three rock holes. One, a small rectangular, shallow, water-filled depression in a limestone stratum, measured 12 by 18 inches with an average depth of 12 inches. The water contained filamentous algae and several clumps of grass. For approximately four hours a day the pool was shaded by a young slash pine (*Pinus caribaea* Morlet). The water had a pH reading of 8.1. From this pool 116 larvae and 7 pupae were collected and one male and three females were taken resting on the sides of the depression.

Contrasted to the previously described breeding habitats were two oölitic limestone solution holes eight feet deep, that measured respectively 6 and 8 inches in diameter at the top. The water level was normally about 6 feet below the soil surface. Both were free of algae and other vegetation and were formed in such a way that the water surface was completely shaded. A total of 307 larvae were collected.

Rearing the larvae under laboratory conditions proved difficult making it necessary that the rearing be accomplished in the field. Containers were placed in breeding holes where individual specimens of larvae were isolated and allowed to pupate and the adults to emerge under natural conditions. Under these conditions it was found the duration of the fourth larval stage to be from 1 to 2 days and the usual duration of the pupal stage to be from 14 to 18 hours. Four males and four females *C. mulrennani* were successfully reared. While many larvae of this species have been collected from their specialized breeding places, adults have rarely been taken except by rearing.

DESCRIPTION OF ADULT

FEMALE: Very small, all-dark species.

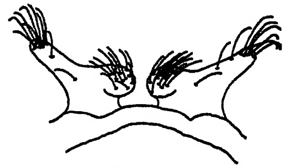
Proboscis.—Long, dark scaled with bronze reflections, tip slightly swollen.

Palpi.—Dark scaled.

Occiput.—Clothed laterally with numerous broad, appressed silvery-gray scales and antero-dorsally with opalescent scales, with a few dark setae anteriorly directed and postero-dorsally with scattered copper to dark brown erect forked scales.

Thorax.—Integument brown, clothed with fine, lanceolate bronze scales.

TRUMPET of PUPA



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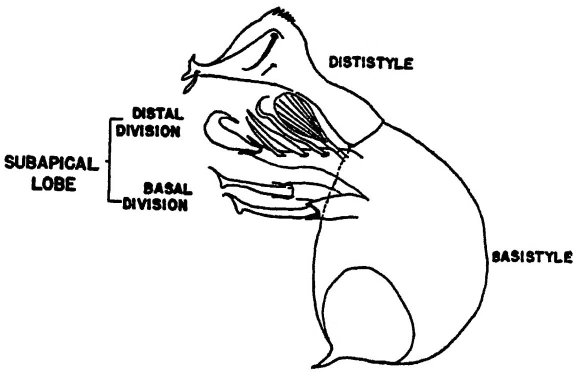
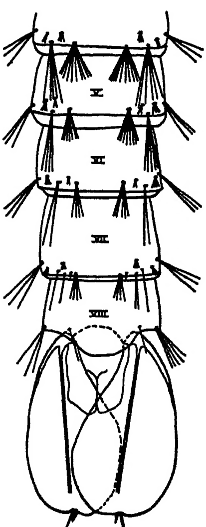
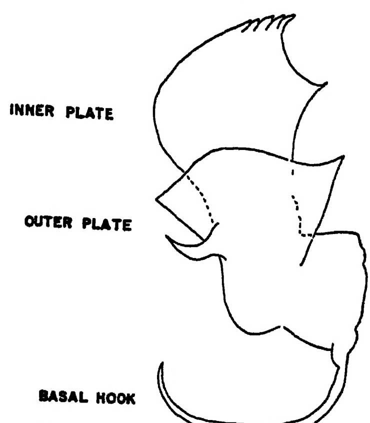




PUPA



PHALLOSOME
(LATERAL VIEW)

Culex (*Melanoconion*) *mulrennani* Basham. Structures of pupa and adult.

Halteres.—Integument of scabellum and mid-halter light, capitellum with dark bronze scales.

Wings.—All dark scaled, plume scales narrow, squame scales broad.

Abdomen.—Clothed dorsally with bronze to dark copper scales, laterally with all dark scales or with minute triangular light spots at the base of posterior segments, ventrally with few basal light scales.

Tarsi.—Dark scaled with apparent bronze reflections.

MALE: Coloration similar to that of the female with the exception of abdominal white scaling being more prominent.

Terminalia (Plate I)[3]. *Lobes of ninth tergite.*—Large, ovate, approximate at bases, apical projection extended laterally, widely separated, clothed with numerous, long smooth setae arising from distinct tubercules on basal and apical portions. (12–16 setae on base and 8–12 on apex.)

Tenth sternite.—Crowned with comb-like row of 9–12 blunt spines.

Phallosome.—Inner plate broad, rounded with 4 or 5 blunt points at the dorsal angle, concave laterally; outer plate with lateral tooth; basal hook long and narrow.

Basistyle.—Large, bulbous, clothed with long, smooth setae on apical half, broad scales on basal half and numerous fine hair-like setae over the entire surface.

Subapical lobe.—Divided into two distinct divisions: Distal division with a striated leaf expanded apically arising from branch at base, followed by a rod-like filament, a lanceolate blade, a short acuminate seta, and a curved narrow leaf; basal division with two long, stout rods tipped with flattened, curved points.

Dististyle.—Three-fourths as long as basistyle, curved, basal third narrowed, medially expanded, cap-like, anterior crest with row of short, reflexed setae, a long curved distinctive spine arising from a groove and a smaller eye seta arising below the spine, preapically constricted, apex below terminal claw sharply projected.

Subterminal appendage.—Finger-like, blunt, subapically inserted, longer than terminal claw.

Terminal claw.—Acutely pointed.

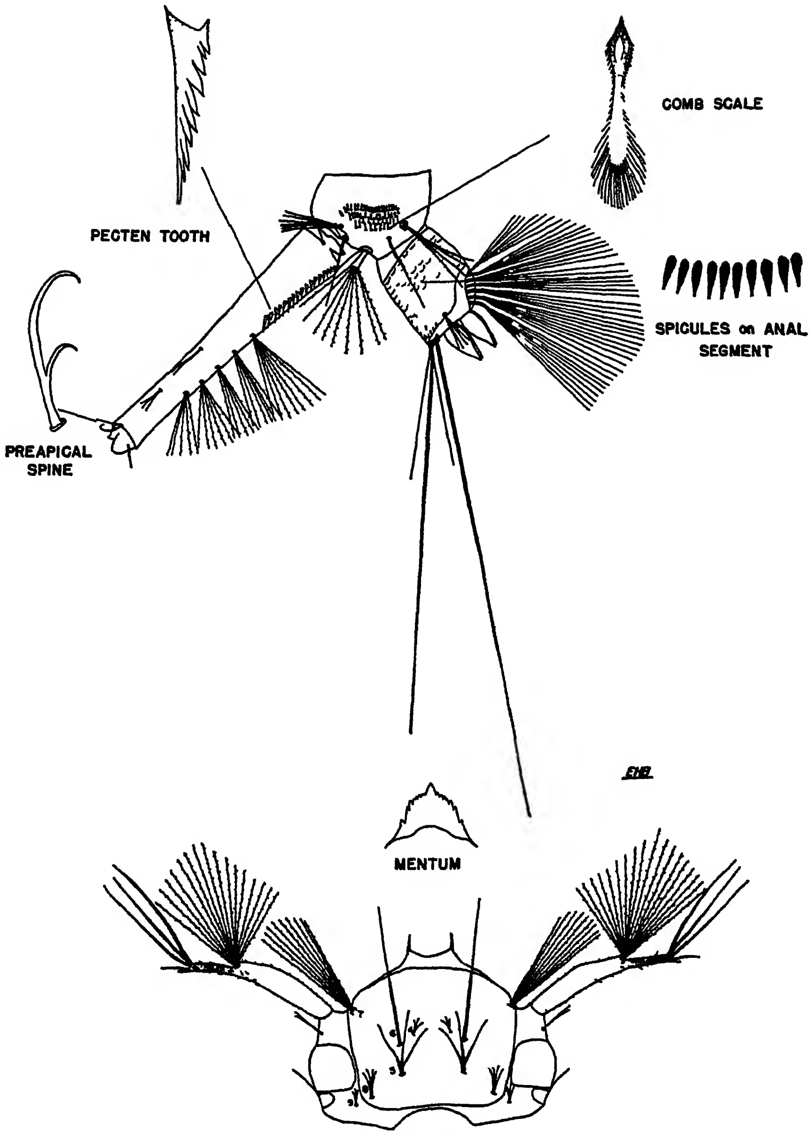
DESCRIPTION OF IMMATURE STAGES

LARVA (Plate II): *Head.*—More or less quadrate, broader than long.

Antenna.—Curved, about as long as head, constricted at apical third with portion before constriction spinose and portion beyond constriction darker with heavier spinules, distinctly more slender than basal portion; antennal tuft large, multiple, branches barbed, inserted in constriction at outer third, reaching beyond tip of antenna; papilla short; a short spine, one long terminal, and two long subterminal spines.

Head hairs.—Preantennal (7) multiple, barbed, extending to antennal tuft; lower (6) long, single; upper (5) usually triple, one-half to three-fourths as long as lower head hairs; postclypeal (4) double or triple; sutural (8) multiple; and transsutural (9) triple.

[3]In describing the characters of the male terminalia and the larva the morphological terms used are those employed by Pratt, *et al.* (1945) and Carpenter, *et al.* (1946).



Culex (Melanoconion) mulrennani Basham   Structures of larva

Mentum.—Seven teeth on either side of a strong median tooth, the basal three teeth decidedly larger and more remotely placed.

Thorax.—Sparsely spiculated.

Abdomen.—Slightly spiculated.

Upper lateral abdominal hairs.—Usually double on segments I and II, triple on segments III to VI.

Eighth segment.—Sparsely spiculated.

Comb.—Numerous scales (45–55) in a triangular patch of three or four irregular rows, the individual scales rounded, expanded apically, the free portion twice as long as base, fringed from base to apex with subequal spinules.

Hair tufts.—*Alpha* multiple, *Beta* single, *Gamma* large, multiple, barbed, *Delta* single, and *Epsilon* multiple.

Siphon.—Slender, 5½ to 7 : 1, with pecten of 16–20 teeth on basal third, individual pecten tooth fringed on one side to tip; five or six pairs of subventral tufts inserted beyond pecten, basal tuft 1½ to 2 times the width of the base of the siphon; two pairs of double or triple subdorsal tufts; dorsal preapical spine longer than apical pecten tooth, recurved with a smaller recurved spine arising at basal third; a median dark-pigmented band variable.

Anal segment.—Longer than wide, completely encircled by anal plate, spiculated in patterns of 12–16 fine spines in slightly concave rows, dorso-apical spines scattered, heavier; lateral hair 3–4 branched from near base; dorsal brush consists of a long, lower caudal hair and an upper caudal tuft of three hairs (one long and two short) on either side; ventral brush well-developed, posterior to plate; gills normal, shorter than segment, tapered.

PUPA (Plate I): Small, approximately 4 times as long as wide.

Trumpet.—5½ times as long as apical width, edges of apical truncation scalloped with a distinct notch at the base (characteristic of subgenus *Melanoconion*), dark-pigmented band on basal third.

The male runs in Wirth's (1945) key to couplet four or five (*C. abominator* D. & K., *C. peccator* D. & K., and *C. anips* Dyar). From these three species it can be separated by the characteristic shape of the dististyle and the lobes of the ninth tergite (see Plate I). The larva runs in Wirth's (1945) key to couplet six (*C. peccator* D. & K. and *C. elevator* D. & K.), but differs as follows: The mentum has seven teeth on either side of a strong central tooth in *C. mulrennani*, six on either side in *C. peccator*, and five on either side in *C. elevator;* upper head hairs multiple in *C. mulrennani* and *C. peccator*, single or double in *C. elevator*, ½ to ¾ as long as lower head hairs in *C. mulrennani* and ¼ to ½ as long as lower head hairs in *C. peccator;* anal gills shorter than sclerotized plate encircling anal segment in *C. mulrennani*, equal or longer than anal segment in *C. peccator;* comb scale expanded apically, free portion twice as long as base in *C. mulrennani*, not markedly expanded apically, free portion equal to base in *C. peccator*.

Holotype male.—Big Pine Key, Monroe County, Florida, July 26, 1947 (D. C. Thurman, Jr.–E. Basham) deposited in the U. S. National Museum with associated larval and pupal skins. *Allotype female.*—Big Pine Key, Monroe County, Florida, July 26, 1947 (D. C. Thurman, Jr.–E. Basham) deposited in the U. S. National Museum with asso-

ciated larval and pupal skins. *Paratopotype* specimens.—Big Pine Key, Monroe County, Florida, seven males, October 13, 1945 (E. L. Seabrook–A. E. Pritchard), seventeen larvae, January 13–16, 1946 (E. L. Seabrook–A. E. Pritchard–M. W. Provost), three larvae, January 24, 1946 (E. L. Seabrook), nine larvae, January 25–27, 1946 (E. L. Seabrook, R. Krueger–A. J. Obermuller), four larvae, March 12, 1947 (Fred Miller), sixteen larvae, March 17, 1947 (Fred Miller), ten larvae, March 31, 1947 (Fred Miller), twenty-six larvae, April 10, 1947 (D. C. Thurman, Jr.), eight larvae, April 14, 1947 (Fred Miller), and 430 larvae and pupae (three males and three females reared), one male and three females, July 24–30, 1947 (D. C. Thurman, Jr.–E. Basham) are in the collections of the Communicable Disease Center, U. S. Public Health Service, Atlanta, Georgia, and the Florida State Board of Health. *Paratype* specimens.—Cudjoe Key, Monroe County, Florida, one larva, October 15, 1945 (E. L. Seabrook–A. E. Pritchard), two larvae, October 30, 1945 (E. L. Seabrook–A. E. Pritchard–M. W. Provost); Ramrod Key, Monroe County, Florida, seven larvae, November 25, 1946 (Fred Miller), ten larvae, March 6, 1947 (Fred Miller), fourteen larvae, March 12, 1947 (Fred Miller), twenty-one larvae, March 16–17, 1947 (Fred Miller), one pupa (reared male), April 16, 1947 (Fred Miller), and one pupa (reared male), April 19, 1947 (Fred Miller) are in the collections of the Communicable Disease Center, U. S. Public Health Service, Atlanta, Georgia, and the Florida State Board of Health.

ACKNOWLEDGMENTS

The author wishes to thank Dr. Alan Stone, Division of Insect Identification, U. S. Department of Agriculture, and Col. W. H. W. Komp, U. S. Public Health Service, for helpful suggestions and opinions following examination of representative specimens. Further acknowledgments are gratefully extended to Mr. D. C. Thurman, Jr., Entomologist, CDC Activities, U. S. Public Health Service, for guidance and valuable criticism in all phases of the study, and to her associates of the Florida State Board of Health who assisted in collecting and preparing the specimens.

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A NEW GENUS OF BLOODSUCKING PSYCHODIDS FROM PERU[1]

(Diptera: Psychodidae)

MARSHALL HERTIG,
Major, Sanitary Corps, AUS.

In the course of studies on Carrion's disease carried out in Peru (Hertig, 1942) thousands of specimens of Phlebotomus were collected. Most of the field work was done in the verruga zone of the Rimac Valley. The sandfly material included all of the three species known from that region, *P. verrucarum*, *P. noguchii* and *P. peruensis*. Collections were made in houses, caves, excavations, pigpens, etc., both by day and by night. Included in the catches were occasional specimens of a psychodid somewhat larger than any of the local species of sandfly, rather like Phlebotomus in general appearance, but obviously not that genus. The first specimen, an unfed female from Puente Carrion in June, 1937, was successfully fed on a verruga patient. It was over a year, however, before another specimen was taken. At that time, the field work was shifted from Puente Carrion to points farther up the valley, where we began to get one or two specimens per month. The bloodsucking habit was quickly confirmed, since several of the first specimens contained red blood. They were taken in caves and houses along with Phlebotomus. Some were kept alive as long as possible in the hope (never realized) of obtaining eggs. Other live or fresh specimens were dissected or put up for sectioning, or mounted in balsam.

There was much spontaneous interest on the part of the whole staff in this new bloodsucking psychodid. In all our field work we were constantly on the look-out for it and there was considerable friendly competition for the honor of capturing the first male. In spite of this active interest the psychodid continued to be represented only by occasional females. About half of them had fed in nature. In September, 1941, after over four years of continuous collecting, the total was only 34 specimens. At the time of writing there are unfortunately not at hand details of the catches during the next year, but this psychodid continued to be rare until about August, 1942. At that time two members of the staff, Dr. Aristides Herrer and Sr. Maximo Puertas, were trying to locate sandfly breeding-places by searching likely spots at or soon after sundown, when sandflies begin to leave their diurnal shelters. At one spot they caught several of the new psychodids at one time, along with Phlebotomus, particularly *P. peruensis*. One of

[1]This work was begun at the Instituto Nacional de Higiene y Salud Publica, Lima, Peru, and was continued as opportunity permitted while stationed at Gorgas Memorial Laboratory, Panama, as member of a unit of Sanitary Corps officers. The latter phases were carried on under a contract recommended by the Committee on Medical Research between the Office of Scientific Research and Development (the contract having been assumed later by the Office of the Surgeon General) and the Gorgas Memorial Laboratory.

the men was seen to be bitten by the new psychodid as well as by Phlebotomus. No males were found. This was near Matucana in the valley which joins the Rimac just below the town. Here, at a place about one kilometer up the valley and on the south side, an irrigation ditch is carried on top of a stone wall past a shallow concavity in the vertical rocky hillside. This spot, known to our staff as *Acequia Cueva*

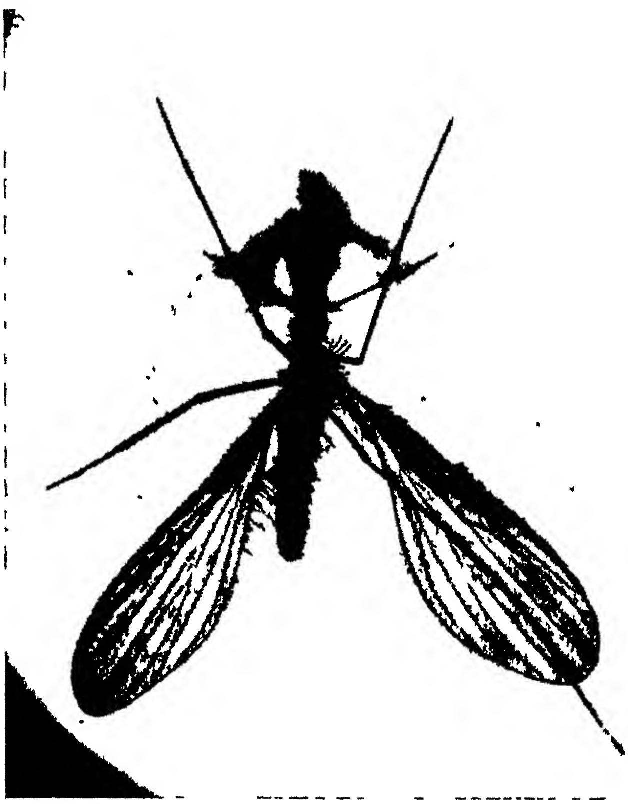


FIG. 1. *Warileya phlebotomanica*, live, unfed female, normal resting position; body and wing scales only slightly rubbed; ×13.5. Compared with Phlebotomus, Warileya is slightly larger and much less hairy. The relatively long, broad and rounded wings are held outward at a greater angle and are more nearly horizontal. For comparison with photographs of several species of Phlebotomus at the same magnification, and for technique of photography, see Hertig (1942).

(ditch cave), was visited repeatedly with the express hope of securing males. All-told, several dozen females were taken, but not until October, 1942, was a male found, when Sr. Puertas sent one alive to the laboratory. Field work was discontinued early in December, 1942, when the writer left Peru. On two subsequent trips to Peru in connection with Army duties, this same place was revisited. In January, 1944, the irrigation ditch had been dry for some time and neither

Phlebotomus nor the new psychodid was found, but in August, 1945, Sr. Puertas caught two males together with about forty females.

The great majority of our specimens have come from Surco and Matucana, i.e., between 2000 and 2400 meters in altitude. Below this level we have taken only six specimens, distributed as follows: Puente Carrion, 2; Lanca, 1; Tornamesa, 1; Huinco (Santa Eulalia valley, 1800 meters), 2. It may be noted that *P. peruensis* is limited to approximately these same altitudes, which mark the upper part of the verruga zone, while the other two species of Phlebotomus occur throughout the whole verruga zone.

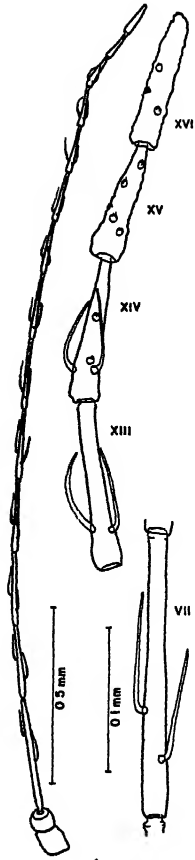
Little is known about the habits of the new psychodid. Man is certainly one of the hosts. In at least two cases biting was observed in nature. Several specimens were fed on man in the laboratory, and 11 out of the first 34 specimens were taken in houses. The rest were taken in caves, stone walls and pigpens. The technique which is successful in inducing oviposition by Phlebotomus, i.e., confining the fed female in a tube with a plug of moist plaster of Paris in one end (Hertig, 1940), failed completely in the case of the new psychodid.

Smears and sections were examined but no experimental work was done with this psychodid. We have no evidence as to any possible role in the transmission of verruga.

We have had access only to limited literature and material of genera other than Phlebotomus. However, a summary of the characters of the psychodid genera which Dr. O. A. Johannsen very kindly, and at considerable labor, provided for us, makes us feel certain that the new sandfly can not be included in any described genus. There is proposed the generic name *Warileya* in honor of W. A. Riley, the teacher and friend of so many of this generation of medical entomologists and parasitologists. The specific name *phlebotomanica* (fond of blood-letting) not only refers to the bloodsucking habit but in embodying the etymology of *Phlebotomus* symbolizes the relation to that genus.

EXPLANATION OF PLATE I

FIG. 1. Head, female, ventral view. The head and its appendages are very similar to those of Phlebotomus. Cibarium: central portion of chitinous arch broad, very faintly sclerotized, sharply outlined only on posterior margin. Cibarial armature limited to numerous very fine hairs (not shown) scattered over the clear area posterior to the chitinous arch; the conspicuous spines, usually found in Phlebotomus. lacking. Fig. 2. Head, female, dorsal view. The frontoclypeal suture is much thicker than in Phlebotomus. Compare with Figure 3. Fig. 3. Head, *P. verrucarum*, female, dorsal view. Compare with Figure 2. Fig. 4. Antenna, with details of certain segments. Number of segments, structure and distribution of ascoids as in Phlebotomus. Fig. 5. A. Palp, five-segmented, Phlebotomus-like; segment III slightly expanded, profile of inner surface with curved depression. B. Segment III, modified scales on inner surface; deciduous scales and fine hairs not shown. C. Segment III, detail of paddle-like, modified scales. There are two compact patches close together, the basal one with about 7 scales, the other with about 24, of which about a third are shown. This same segment in Phlebotomus characteristically bears similar modified scales either scattered or in patches. Fig. 6. Wing, female. The wing is broad with rounded apex, compared with the narrow, pointed wings of Phlebotomus in general; venation essentially the same; bases of R_{2-3} and M_1 faint and with pronounced curve.



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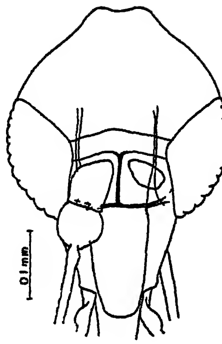

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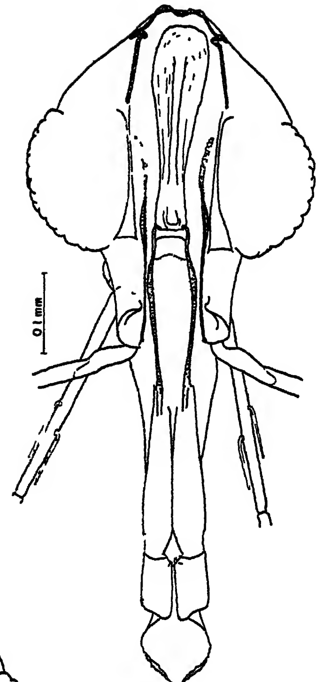

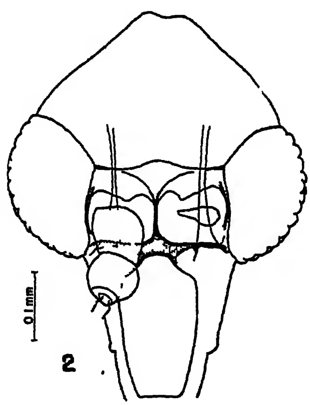

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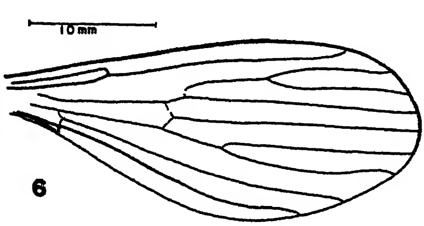

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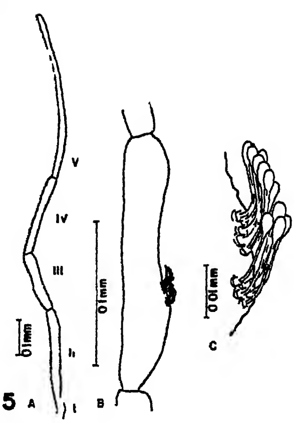


5

Warileya phlebotomanica, gen. et spec. nov.

Drawings made with the aid of the camera lucida, from balsam mounts except as noted.

Warileya phlebotomanica, gen. et spec. nov.
Plates I, II

General appearance, similar to Phlebotomus; slightly larger and much less hairy than most species of that genus; light yellow in color. As seen grossly the most marked differences are in the wings which are relatively very large with rounded apices. They are held outward at a greater angle and are more nearly horizontal than in Phlebotomus. The photograph of a live, normal, unfed female may be compared with those of various species of Phlebotomus, at the same magnification, shown in Plate 5, Hertig, 1942.

In nature Warileya has the same short, hopping flight characteristic of Phlebotomus.

Head (Figs 1–5) closely similar to Phlebotomus, the antennae and palps having the same relative proportions, position and number of segments.

Proboscis as in Phlebotomus. No significant differences in the stylets were noted in the dissection of various specimens.

Antennae (Figs. 1, 4). Ascoids simple, geniculate, on segments III to XIV, extending to distal third of segment.

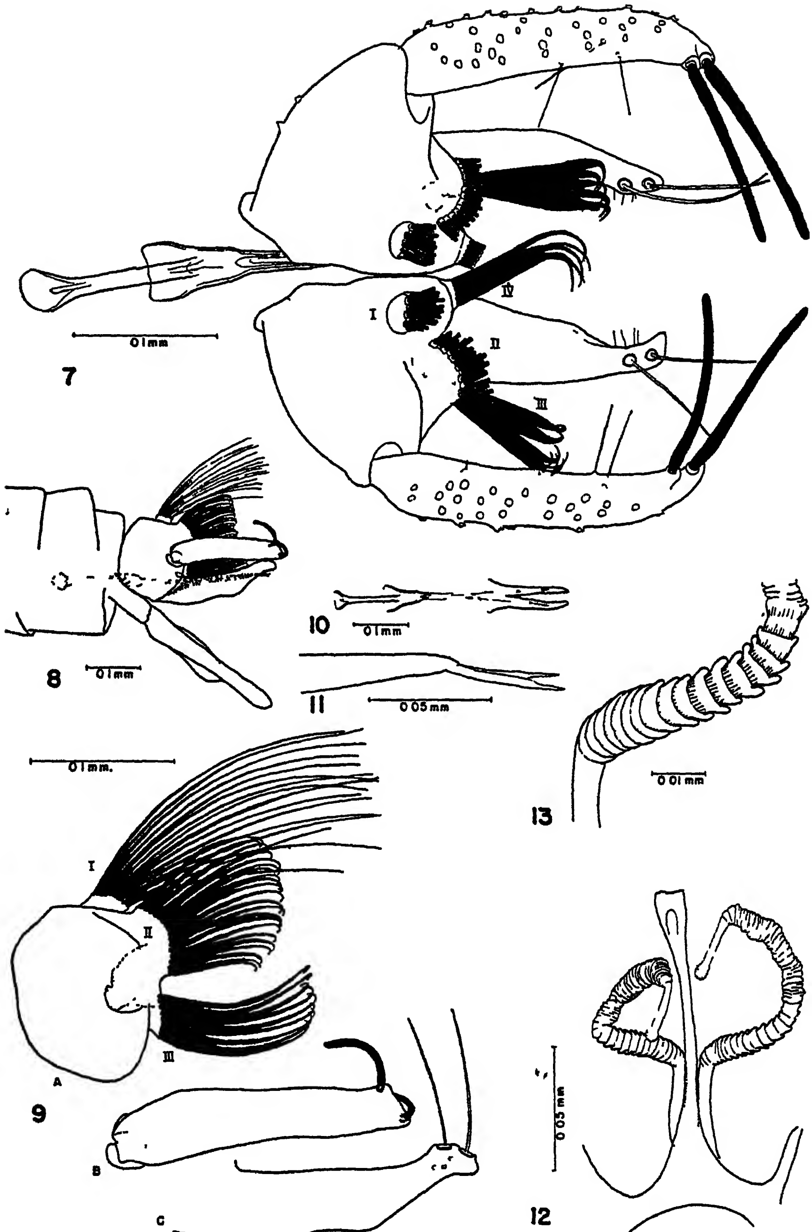
Palps (Fig. 5). Segment III slightly expanded, inner surface with curved depression as seen in profile; two patches of paddle-like, modified scales on inner surface at basal third. Similar modified scales, scattered or in patches, are found on the same palpal segment in Phlebotomus.

Frontoclypeal suture (Fig. 2) much thicker than in Phlebotomus (Fig. 3).

Cibarium, female (Fig. 1). The characteristic *armature* of Phlebotomus (conspicuous spines or teeth) lacking. However, the whole area posterior to the chitinous arch is studded with very fine spines or hairs (not shown in figure), which are more numerous and longer at the sides.

EXPLANATION OF PLATE II

Fig. 7. Male genitalia, dorsal view; phenol mount. The coxites are short, heavy truncated cones extending outward at right angles to the body axis, their dorso-posterior surfaces bearing four tufts of long heavy spines. The dorsal tufts are drawn as though cut off near their bases. The widely separated tips of the aedeagus are indicated by dotted lines. Lateral lobes not shown. Fig. 8. Male genitalia, side view; balsam mount. The lateral lobes arise from a common base, making them Y-shaped in dorso-ventral aspect. Fig. 9. Details, same preparation as Fig. 8. A. Coxite, only three of the four tufts shown. B. Style. C. Paramere. Fig. 10. Genital pump, filaments, aedeagus, dorsal view; same preparation as Fig. 7. Fig. 11. Tips of genital filaments extruded from aedeagus, side view; same preparation as Fig. 8. Exact location of openings not made out. Fig. 12. Spermathecae and part of genital fork, ventral view; balsam mount. The central portion of the spermathecae is composed of conspicuously sclerotized, telescoping annulations; distal portion thin-walled, with irregular trachea-like thickenings; basal part of ducts thin-walled but smooth and sharply defined. In phenol preparations the latter have been seen to empty separately into very thin-walled structures which broaden as they extend toward the posterior edge of the genital fork. Fig. 13. Spermatheca, detail, same preparation as Fig. 12. Each annulation bears on the inner surface a row of very fine hairs. Comparable structures have not been observed in Phlebotomus.


IV
I
II
III
0.1 mm
7
8
0.1 mm
10
0.1 mm
11
0.05 mm
13
0.01 mm
0.1 mm.
I
II
III
A
9
B
C
0.05 mm
12

Chitinous arch heavily sclerotized only at the sides, the central portion a broad, faint band best seen in stained preparations, with only the posterior margin sharply defined.

Pharynx similar to Phlebotomus; posterior portion with folds, some with fine spines.

Wing (Fig. 6) broad with rounded apex, unlike the narrow, pointed wings of Phlebotomus; long in proportion to body length; scales along veins and margin very slender, never obscuring the venation, even in unrubbed specimens. *Venation* essentially the same as Phlebotomus; bases of R_{2-3} and M_1 very faint and with pronounced curve; fork of R_4 and R_5 close to base of R_{2-3}, making *gamma* very short.

Male genitalia (Figs. 7–11) strikingly different from Phlebotomus in general appearance, chiefly on account of the position and shape of the coxites and the enormous tufts which they bear. The structures are best seen in dorso-ventral aspect.

Coxite (Figs. 7–9) short, heavy, conical, extending laterally at right angles to the body and bearing four separate tufts of long, heavy spines on the dorsal and posterior surfaces:

Tuft I, about 20 long, curved spines arising as a compact clump from a circular prominence on the dorsal side and spreading so as to obscure partially the other tufts.

Tuft II, a double row of about 24 heavy spines, curved inward at the tips.

Tuft III, a single row of about eight flattened spines, thin at the edges and curving inward at the tips, arranged like the ribs of a folded fan.

Tuft IV, a single row of about six heavy spines with curved tips, the basal portion apparently fused. This tuft is obscured by the others in both lateral and dorsal view.

Style (Figs. 7–9) slender, cylindrical, with two heavy, apical spines; two or three fine, long, apparently non-deciduous hairs at the distal third.

Paramere (Figs. 7–9) simple, with two long, slender, colorless, dorsal, apical spines and several fine hairs on the inner surface near the apex.

Lateral lobes (Fig. 8) straight, diverging from a common base to form a Y.

Aedeagus (Figs. 7, 8, 10, 11) more deeply divided than in most species of Phlebotomus, the tips rather widely separated.

Genital pump and *filaments* (Figs. 7, 8, 10, 11) as in Phlebotomus.

Female genitalia. *Cerci* similar to Phlebotomus.

Spermathecae (Figs. 12, 13) paired tubes; basal portion smooth, sharply defined, followed by nearly twenty telescoping annulations, conspicuously sclerotized, each annulation bearing on the inside a row of extremely fine hairs; distal portion thin-walled with irregular, trachea-like thickenings, terminating in a straight slender tube with a knob-like expansion. The very fine hairs which, in Phlebotomus, usually radiate from this terminal knob or "head" have not been made out, although there are dot-like structures which could represent their bases.

In phenol mounts, the ducts have been seen to empty separately into two very thin-walled, flat structures which broaden as they extend toward the posterior margin of the genital fork. The details have not been made out.

A comparison with Phlebotomus is difficult since that genus displays a fantastic series of variations of what are fundamentally paired ducts with a common basal portion and ending usually in a marked expansion, which apparently serves as a reservoir, surmounted by a protuberance bearing fine hairs of unknown function. In Warileya the ducts are completely separate and there is no expanded portion. Internal hairs have not been noted in Phlebotomus.

TABLE I

MEASUREMENTS IN MILLIMETERS

Warileya phlebotomanica

	Two Males		Six Females		
	Balsam Mount	Temporary Phenol Mount	Balsam Mounts Max.	Min.	Mean
Body length (thorax + abdomen, excluding ♂ hypopygium)	1.97	1 64	2 49	1.85	2 27
Head—					
Total length, including proboscis	.70	.71	.99	.79	.89
Vertex to anterior margin of clypeus	.43	....	.71	.46	.55
Head, width	.35	....	.44	.29	.37
Eye, length	.17	....	22	.17	.19
Vertex to eye, lateral profile	.19	....	.21	.18	.20
Antenna, segments III-XVI	1 97	2.14	2.36	1.85	2.16
Segment III	.32	.31	.33	.28	.31
Palp, segments I + II	.25	.26	.38	.29	.33
III	.17	.16	20	.15	.17
IV	.18	.21	.25	.14	.20
V	.41	.47	.50*	.43*	.47*
Wing, length	2 90	3.04	3.74	3 01	3.40
Width	1 08	1.10	1 43	1.12	1.25
alpha	.79	.78	1 09	.84	.95
beta	.50	.51	.59	.46	.53
gamma	.05	.03	.12	.03	.06
delta	.40	.41	.68	.52	.59

*The fifth palpal segments of the six females measured were somewhat shrunken. For this segment there have been substituted measurements of seven females subsequently mounted with little or no distortion.

Holotype male.—Specimen B, near Matucana, Rimac Valley, Peru, at the "Acequia Cueva" described above, 23 Aug., 45, coll. M. Puertas. Figures 7 and 10 were drawn from this specimen. One other male and at least 25 females were taken on the same occasion.

Allotype female, same place, date and collector as holotype.

Paratypes.—On hand at time of writing (Panama, 1947), all locations in Rimac Valley, Peru, 2 males, 55 females, as follows:

Males: slide, 1 ♂, Matucana, Acequia Cueva, 27 Oct., 42, coll. M. Puertas; in alcohol, 1♂, same place and collector, 23 Aug., 45.

Females: slides: 1 ♀, Puente Carrion, June, 37; 1 ♀, Matucana, Nov., 39; 2 ♀, Surco, 8 Aug., 42; 2 ♀, no data, but same region prior to 1942; 9 ♀ Matucana, Acequia Cueva, 23 Aug., 45. In alcohol: 1 ♀, Matucana, 21 Nov., 39; 1 ♀, Matucana, cave with mouse, 4 Nov., 40; 1 ♀, Rimac Valley before 1942; 1 ♀, Surco, biting man, 20 Aug., 45, coll. A. Herrer; 2 ♀, Surco, cave, 1 each on 23 and 25 Aug., 45; Matucana, Acequia Cueva, 16 ♀ on 23 Aug., 45, 18 ♀ on 25 Aug., 45, coll. M. Puertas. Where not specified, collectors were the field and laboratory staff or the writer.

Various additional females (labeled Psychodidae-X)were left at the Instituto Nacional de Higiene y Salud Publica, Lima. Since August, 1945, Sr. A. Caballero, Dr. Herrer's assistant, has collected a number of females and at least one male at the Matucana Acequia Cueva, which have been examined in alcohol by the writer.

Types to be deposited in the U. S. National Museum, Washington.

REFERENCES

Hertig, M. 1940. Glass tubes for rearing Phlebotomus and other insects. Science, 92: 91–92.

1942. Phlebotomus and Carrion's disease. Suppl. to Amer. Jour. Trop. Med., vol. 22, No. 5, July, 1942, 81 pp.

INSECTS AND HUMAN WELFARE, by CHARLES T. BRUES. xiii+154 pages, 14 figures, 1947. Harvard University Press, Cambridge, Mass. Price $2.50.

In this small volume Dr. Brues presents an unusually entertaining survey of the relations of insects and some of their arthropod relatives to man. The material included is largely familiar to professional entomologists and should be familiar to all of them, but even they should find it worth reading and useful for the compact presentation of significant data. The reviewer would recommend the book principally to readers who are not specialists in entomology but who are concerned with all matters affecting the welfare of our species. In spite of the remark of an editor some years ago to the effect that people do not like to read about insects, he does not see how anyone could fail to profit by reading this book nor to enjoy it in some degree.

In his brief introduction the author mentions some of the interesting relations of insects to man and the positive value of such species as the lac insects and the honey-bee, and states as his purpose the treatment of the many species which "bear a less pleasant relation to man." These troublesome creatures are discussed in four chapters, headed respectively Insects and the Public Health, Insects and the Food Supply, Forest Insects and Household Insects. A final chapter, The Outlook for the Future, presents briefly an optimistic opinion of our future relations with insects without minimizing the fact that they will continue to be economically important and occasionally serious pests. The figures are graphic representations of statistical data.

Insects and Human Welfare is a worthy addition to the publications of an eminent entomologist and is a fine tribute to his broad information and comprehension of the science.—A. W. L.

NEW NEARCTIC RHYACOPHILIDAE AND PHILOPOTAMIDAE
(Trichoptera)

HERBERT H. ROSS,
Illinois Natural History Survey,
Urbana, Illinois

Examination of additional collections of Trichoptera from various parts of North America has brought to light several new species, seven of which are described in this paper. To ascertain the placement of the new genus in Philopotamidae, it has been necessary to attempt a tabulation of related world genera, and while the resulting key is preliminary and undoubtedly imperfect, it is presented in the hope that it will be a useful step in an analysis of the family.

I am greatly indebted to Dr. Donald W. Scott, University of Georgia, Atlanta, Ga., and to Mr. Kenneth M. Fender, McMinnville, Ore., for sending me certain of the material used in this paper. Types are deposited in the collection of the Illinois Natural History Survey.

Rhyacophilidae

Rhyacophila parantra n .sp.

This species is a close relative of *banski* Ross, agreeing with it in the small aedeagus, incised clasper, and the possession of an apical projection on the ninth tergite. It differs from *banksi* chiefly in the shape of this projection. In *parantra* the projection extends almost in line with the dorsal contour of the ninth tergite, is much thicker, and is parallel-sided and only slightly incised on the meson. In *banksi* Ross, (1944, p. 268, fig. 908 A, B) this projection is set at an angle of nearly 45° to the dorsal line of the ninth tergite, is thinner, and is constricted at the base and more widely excavated at the apex.

Male.—Length 9 mm. General body color various shades of light brown, the lighter shades predominating on the venter; head having a darker brown area covering most of the dorsum; antennae with basal two segments yellow, remainder dark brown; legs yellowish, the spurs darker brown; and wings uniformly light brown with no pattern. General structure, including ocelli, spurs, and venation, typical for genus. Genitalia, fig. 1, distinctive for the species. Ninth segment nearly cylindrical, at the middle nearly a third as long as deep; the postero-dorsal portion is produced into a short, straight projection, only slightly raised above dorsal profile of segment, the projection truncate from lateral view, slightly incised mesally from dorsal view, fig. 1A. Tenth tergite having flangelike dorsal projections on lateral lobes, each flange set into the lateral aspect of the lobe and not confluent with the dorsal contour; mesal lobe having a bulbous apex of moderate size. Clasper short and distinctly 2-segmented; basal segment deeper than long; apical segment deeply incised to form a long, sharp dorsal lobe, clothed

with scattered setae, and a longer ventral lobe which is thick, finger-like, and almost spatulate, bearing an inner brush of short black spines. Aedeagus short, its basal part barrel-shaped, the extrusible portion composed of a short dorsal hook and short lateral arms.

Female.—Size, color, and general structure as for male. Structure of segments 8 to 10 very much as for *banksi* Ross (1944, p. 268, fig. 908, C, D); eighth segment swollen ventrad, its apical margin sinuate laterad, nearly truncate ventrad, occasionally with a pair of small projections but these not well developed as in *banksi*.

Holotype, male.—Stream at Twin Lakes, 2 mi. W. of Bloomington, Indiana, May 28, 1947, D. W. Scott. *Allotype*, female.—Monroe State Forest, Morgan, Indiana, May 19, 1946, D. W. Scott. *Paratypes*, all from Indiana.—Same data as for holotype, 9 ♂, 2 ♀, same data as for allotype, 3 ♂, 2 ♀; Blair Springs, Monroe Co., June 4, 1947, D. W. Scott, 2 ♂, 1 ♀; Speed Hollow, Lawrence Co., June 12, 1947, D. W. Scott, 3 ♂, 2 ♀.

All of these specimens have been taken near the source of streams issuing from caves or springs in the limestone area of south-central Indiana. These streams are permanent, cold, and clear, with a fairly rapid flow maintained at all seasons.

As pointed out above, *parantra* and *banksi* form a closely knit complex of two species. The latter is known only from some of the cold streams of New Hampshire, located about 700 miles from the restricted area from which *parantra* is known. This raises the interesting speculation that these two species may have differentiated from each other since the isolation by glacial retreat of similar parental populations in the two areas.

Rhyacophila fenderi n. sp.

In the male, the cut-away ninth segment and deeply concave apical segment of the clasper indicate that among known forms this species is related only to *perda* Ross (1938, p. 105, fig. 7). Several striking differences set off *fenderi*, most prominent of which are the stout mesal projection of the ninth tergite, the extremely reduced dorsal lobe of the clasper, and the curious triangular mesal bodies of the tenth tergite, fig. 3.

Male.—Length 8 mm. Head and body various medium shades of brown, darker dorsad, lighter ventrad; antennae and legs light yellow; wings uniformly light brown, without pattern. General structure typical for genus, including mouthparts, ocelli, spurs, and venation. Genitalia, fig. 3, distinctive for species. Ninth segment cylindrical, nearly twice as long dorsad as ventrad, the posterior margin cut away to form a sharp angle beneath the longer dorsal portion; the dorsum dips down at apex, and from the base of this dip projects a sharp, thin, beaklike process. Beneath this fit the structures of the tenth tergite, which include a pair of large lateral lobes confluent on the meson and a pair of mesal processes that are subtriangular, wide at base, and taper evenly to a very narrow but truncate apex, fig. 3A. Claspers distinctly 2-segmented; basal segment almost rectangular, longer than deep; apical segment with only a minute dorsal lobe but a long, deeply exca-

vated ventral lobe which is rounded at apex and bears a sharp flange around the basal and ventral margins of the excavated area. Aedeagus composed of three sets of elongate parts very similar to those of *perda*.

Holotype, male.—Peavine Ridge, near McMinnville, Oregon, Aug. 6, 1947, Kenneth M. Fender. *Paratypes*.—Same data as for holotype, but Sept. 13, 1946, 3 ♂.

Rhyacophila ophrys n. sp.

The general conformation of the tenth tergite and the unindented apical segment of the clasper show a close relationship between this species and *abchasica* Martynov, described from a mountainous torrent in Abkhasia. In *ophrys* the apical segment of the clasper is shorter than deep and ovoid, and the dorsal lobes of the tenth tergite are separated on the meson by a wide "V;" in *abchasica* the apical segment of the clasper is longer than deep, the ventral corner is angulate, and the whole trianguloid, and the dorsal lobes of the tenth tergite are contiguous almost to the apex.

Male.—Length 8.5 mm. Color of body and all the appendages reddish brown, remarkably uniform in shade throughout, only the venter and a few of the leg joints lighter. General structure typical for genus. Genitalia as in fig. 4. Ninth segment cylindrical, nearly twice as long dorsad as ventrad, the posterior margin gently sinuate, the postero-dorsal portion suddenly curved downward so that the tenth tergite attaches to it some distance below the dorsal margin. Tenth tergite having lateral lobes forming a pair of dorsal shelves separated by a deep, V-shaped cleft, fig. 4A; on the under side of each shelf is a sharp curving ridge which rounds into the base of the shelf. The mesal lobes of the tergite form a short, straight internal rod and end in a round reticulate area. Claspers distinctly divided into two segments; basal segment considerably longer than deep, slightly narrowed just beyond base, but otherwise nearly parallel-sided; apical segment deeper than long, none of the corners angulate, the whole forming an ovoid structure. Aedeagus short, consisting of a short outer "barrel;" a short, slender, spikelike mesal piece; and a pair of flat lateral flaps, the long dimension dorso-ventral in position, the apical portion bearing a large, mesal, brushy area.

Female.—Size, color, and general structure similar to male. Genital segments relatively short. Eighth segment having dorsal length subequal to depth, the ventral length longer due to the production of the ventro-mesal portion into a rounded apical portion; lateral aspect having apical margin evenly sinuate.

Holotype, male.—East of summit of Logan Pass, Glacier National Park, Montana, July 12, 1940, J. A. and H. H. Ross. *Allotype*, female.—Same data as for holotype. *Paratypes*.—Same data as for holotype, 21 ♂, 23 ♀.

Rhyacophila belona n. sp.

The projecting, parallel-sided, and cleft tenth tergite, fig. 2A, allies this species with *vetina* Milne and the *angelita* group. From the latter *belona* differs in lacking a pair of extensile pads on the aedeagus and in

the sinuate lateral aspect of the tenth tergite. From *vetina*, *belona* differs in the trapezoidal apical segment of the clasper and the sinuate dorsal margin of the tenth tergite. In *vetina* the apical segment of the clasper is incised and shoe-shaped.

Male.—Length 10.5 mm. Color of entire body and appendages reddish-brown except for the extreme base of each tarsal segment which is whitish. Genitalia as in fig. 2. Ninth segment cylindrical, the dorsal length nearly twice the ventral length, the apico-lateral margin oblique and nearly straight. Tenth tergite elongate, parallel-sided, and shelflike, fig. 2A, sinuate in lateral view with a large ventral lobe near base, and cleft about halfway down the meson, the cleft nearly closed at apex but elliptic at base. Clasper distinctly 2-segmented, the basal segment straight sided and tapering slightly to apex, nearly as long as tenth tergite, and the apical segment trapezoidal with a round apico-ventral corner. Aedeagus having a broad, short basal portion and a long, central, projecting, sclerotized process which is flanged on its basal half and spikelike apically.

Holotype, male.—East of summit of Logan Pass, Glacier National Park, Montana, July 12, 1940, J. A. and H. H. Ross.

This and the preceding species were swept from shrubbery along a small, rocky, mountain cascade at an elevation of about 6000 feet.

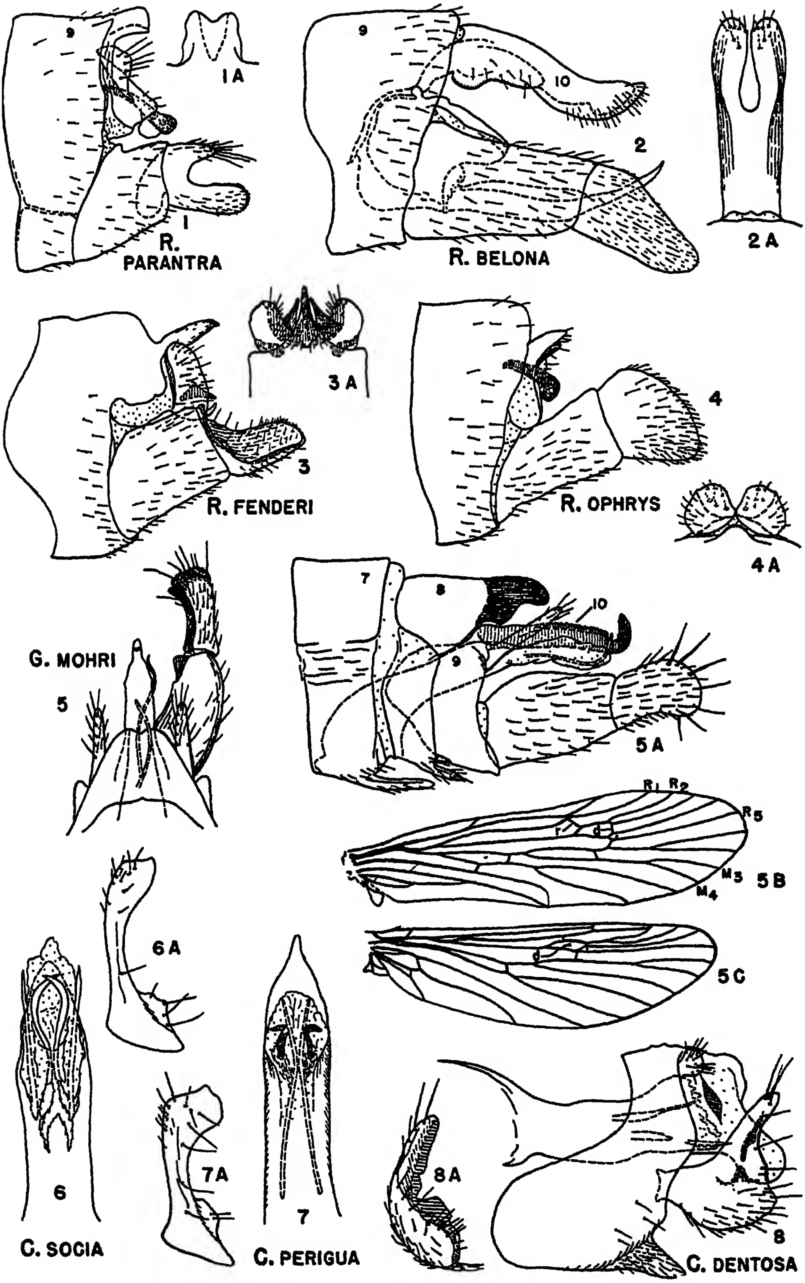
Philopotamidae

The family Philopotamidae appears to be a small, compact family of world wide distribution, and contains relatively few described genera. An analysis of these on the basis of male genitalia brings out an interesting set of conditions: in *Chimarra* the clasper is 1-segmented, in *Philopotamus* the clasper is 2-segmented and has an additional sausage-like appendage on the apical segment, and in the remaining genera the clasper is 2-segmented with no additional major divisions. This latter group is surprisingly uniform in the general type of genitalia exhibited, but appears to be divisible into several generic types substantiated by both wing venation and larval and pupal characters, in cases in which the latter are known.

Based on illustrations of the labrum, *Philopotamopsis* Iwata (described from larvae) appears not to belong to this family.

EXPLANATION OF PLATE I

Fig. 1. *Rhyacophila parantra*, male genitalia, lateral aspect. 1A, tenth tergite, dorsal aspect. Fig. 2. *Rhyacophila belona*, male genitalia, lateral aspect. 2A, tenth tergite, dorsal aspect. Fig. 3. *Rhyacophila fenderi*, male genitalia, lateral aspect. 3A, tenth tergite, dorsal aspect. Fig. 4. *Rhyacophila ophrys*, male genitalia, lateral aspect. 4A, tenth tergite, dorsal aspect. Fig. 5. *Gatlinia mohri*, male genitalia, dorsal aspect. 5A, same, lateral aspect. 5B and C, front and hind wings. Fig. 6. *Chimarra socia*, aedeagus, dorsal aspect. 6A, clasper, posterior aspect. Fig. 7. *Chimarra perigua*, aedeagus, dorsal aspect. 7A, clasper, posterior aspect. Fig. 8. *Chimarra dentosa*, male genitalia, lateral aspect. 8A, clasper, posterior aspect.


9
1A
1
R. PARANTRA
9
10
2
R. BELONA
2A
3A
3
R. FENDERI
4
R. OPHRYS
4A
G. MOHRI
5
7
8
10
9
5A
R1 R2
R5
r
d
M3
M4
5B
5C
6A
6
C. SOCIA
7A
7
C. PERIGUA
8A
8
C. DENTOSA

KEY TO GENERA

1. Wings reduced to small, inconspicuous stubs. Some females of **Dolophilodes** Ulmer
   Wings well developed, reaching beyond apex of abdomen.................. 2
2. Front tibia having one apical spur or none................**Chimarra** Stephens
   Front tibia having two apical spurs...................................... 3
3. Front wing having M_{3+4} unbranched..................**Wormaldia** McLachlan
   Front wing having M_{3+4} branched into M_3 and M_4, fig. 5B................ 4
4. Front wing, fig. 5B, having Sc and R_1 sinuate, touching or nearly touching at base of stigmal area. Both wings having discoidal cell (d) very small; branches of R_s crowded close together, especially in hind wing. Hind wing, fig. 5C, with tips of R_1 and R_2 meeting.........**Gatlinia** new genus
   Front wing having Sc and R_1 nearly straight, never close to each other. Hind wing with tip of R_2 distant from tip of R_1....................... 5
5. Front wing having R_{2+3} simple, without a fork.........**Dolophilus** McLachlan
   Front wing having R_{2+3} divided into R_2 and R_3.......................... 6
6. Front wing with fork of R_{2+3} almost directly above that of R_{4+5}............ 7
   Front wing with fork of R_{2+3} considerably distad of that of R_{4+5}........... 9
7. Maxillary palpus very long, having segment 4 subequal in length to 1 and 2 together, and segment 5 three times length of 4. Australian species, **Hydrobiosella** Tillyard
   Maxillary palpus shorter, having segment 4 subequal to 2 only, and segment 5 usually only twice length of 4. African and holarctic species............. 8
8. Discoidal cell subequal in length to cell R_2; cross-vein *r* situated basad of fork of R_{2+3}, and considerably basad of discoidal cross-vein. African species...**Thylakion** Barnard
   Discoidal cell little more than half length of cell R_3; cross-vein *r* situated at fork of R_{2+3}, and only slightly basad of discoidal cross-vein. Species of holarctic region.............................**Dolophilus** McLachlan
9. Male clasper having a tubular, finger-like appendage arising from base of apical segment and as long as this latter segment; female eighth segment cylindrical and forming a ring of nearly equal length at all points, **Philopotamus** Leach
   Male clasper 2-segmented but with no appendage; female eighth segment having its apico-ventral margin deeply incised, so that the ventral length of the segment is only a third or a fourth of the lateral length, **Dolophilodes** Ulmer

Genus **Gatlinia** nov.

Characteristics.—General structure typical of the family Philopotamidae, as follows: head having three large ocelli, the lateral ones separated by twice their width from margin of eye; maxillary palpi 5-segmented, the first, second, and fourth subequal, the third nearly twice as long as the fourth, the fifth nearly three times as long as the fourth and much narrower, but without suture-like cross-striae typical of many Philopotamidae. Tibial spur count 2–4–4, the spurs on the front tibia much shorter than the others. Front wing, fig. 5B, following in general the venation of other members of the family, with the following salient characteristics: Sc_2 deeply bowed near apex, R_1 curved sharply forward at the same point, the two either touching or nearly so at this point; R_{2+3} and R_{4+5} both branched, discoidal cross-vein close to main branch of R_s so that discoidal cell is short; R_{2+3} branching either at discoidal cross-vein, fig. 5B, or some distance beyond it; M having all four branches distinct. Hind wing, fig. 5C, having several modifications from the generalized type for the family, as follows: branches of R_s crowded together; R_2 curving upward and fusing with tip of R_1; R_{2+3} branched some distance beyond discoidal cross-vein; discoidal cell

very small; venation posterior to this not at all crowded and typical for group.

Genotype.—*Gatlinia mohri* n. sp.—This genus is most closely related to *Dolophilus*, but differs from it in venational characters mentioned in the key. The female has the eighth segment sclerotized and short, suggesting an affinity to *Dolophilodes*, from which *Gatlinia* differs in the short discoidal cell and crowded condition of R_s in the hind wing.

Gatlinia mohri n. sp.

The male genitalia of this species resemble in general pattern those of species of *Dolophilus* and *Dolophilodes*, but differ from all of them in the heavily sclerotized and hoodlike projection of the eighth tergite.

Male.—Length 7 mm. Color of body and appendages various shades of medium brown, the legs and venter paler and yellowish. General structure as outlined for genus. Seventh sternite having a broad, tongue-like, apico-mesal flap that is as long as the segment; eighth sternite having a similar but shorter and slightly narrower flap. Eighth tergite having its apical margin produced into a long, wide, sclerotized hood extending over the ninth and base of the tenth tergites. Genitalia as in figs. 5 and 5A. Ninth segment triangular from side view, the tergal portion greatly reduced; the tenth tergite is contiguous with it and forms a long, mesal, sclerotized process that is upturned at apex to form a stout hook and has on each side a serrate flange; at the base of the tenth tergite arise the finger-like cerci. Claspers distinctly 2-segmented; the basal segment is one and a half times the length of the apical one and slightly swollen near base; the apical segment curves slightly ventrad and mesad, is armed with a few long, lateral setae at apex, is smooth and concave mesad, and bears along its apical face a series of rows of short, stout black pegs together giving the appearance of a dense brush. Aedeagus mostly membranous, tubular inside the body and having membranous folds at the apex, bearing also two long, sinuate, slender sclerotized rods which may extrude from the apex.

Female.—Similar in size, color, and general characteristics to male. Seventh segment large and slightly bilaterally compressed, bearing a short baso-mesal projection on venter. Eighth segment small, sclerotized laterally, and having a narrow ventro-mesal line which is only semi-sclerotized. Ninth and tenth segments also short, only the extreme base of the ninth sclerotized. Eighth and ninth segments each having a pair of rodlike apodemes arising from base and extending internally towards the anterior part of the abdomen.

Holotype, male.—Smokemont, North Carolina, May 11, 1944, Frison and Ross. *Allotype*, female.—Same data. *Paratypes.*—Tennessee: Gatlinburg, along Little Pigeon River, June 13, 1940, Frison *et al*, 1 ♂, 3 ♀; May 11, 1944, Frison and Ross, at lights in town, 2 ♂; May 11, 1944, Frison and Ross, along Little Pigeon River, 8 ♂, 6 ♀.

The specimens collected at Gatlinburg in 1940 and at Smokemont in 1944 were obtained by sweeping foliage along the rapid mountain streams mentioned. The larger Gatlinburg collection made along the Little Pigeon River on May 11, 1944, was taken while searching primarily for stoneflies among the rocks along the stream bed. Earlier in

the morning no caddisflies were in evidence, but about noon a bank of rainclouds rolled in, causing an extremely high humidity which combined with the warm spring temperature to produce stifling and, to the collectors, uncomfortable conditions. Almost immediately caddisflies appeared in great numbers on the rocks of the stream bed, running and flitting about with great alacrity. We had time to pick up only a small collection of the caddisflies before a torrential downpour dissolved the insect band and brought an end to collecting.

Genus **Dolophilodes** Ulmer

Dolophilodes Ulmer, 1909, Notes Leyden Mus. *30*: 125. Genotype, monobasic.—*D. ornata* Ulmer.

Trentonius Betten & Mosely, 1940, Francis Walker Types of Trichoptera in the Brit. Mus.: 11. Genotype, by original designation—*Philopotamus distinctus* Walker.

When the genus *Trentonius* was originally described, only apterous females were known for the genotype, *distinctus*, and this characteristic was one of the main considerations in segregating the genus. Later discovery of normally winged females during summer generations of that species has reopened the question of the relationship between *Dolophilodes* and *Trentonius*. A comparison of Old and New World members of the complex shows that *ornatus* Ulmer, *distinctus* (Walker), and *aequalis* (Banks) form one of the most closely knit groups of species in the entire assemblage. As a matter of fact, *ornata* resembles *aequalis* very much as regards male genitalia. Ulmer illustrates *ornata* as having R_{2+3} unbranched in the hind wing; in *distinctus* and other nearctic species this vein is branched; but in *aequalis* the vein is branched in some specimens, unbranched in others. It would appear therefore that in this case similarities indicated by male genitalia are of more significance than those based on venation.

On this basis the genus *Trentonius* is here considered a direct synonym of *Dolophilodes*, to which must be transferred the American species listed under *Trentonius* by Ross (1944).

Genus **Chimarra** Stephens

At this time I wish to draw attention to the omission from my 1944 Checklist of a species described as *Wormaldia Buenoi* by Navas (1934, Broteria, Lisbon, n. ser. *3* (old ser. 30): 83, fig. 49) from Yaphank, L. I., N. Y. I have seen no type material of this species but it seems highly probable that Navas' material belonged to *C. aterrima* (Hagen). Navas illustration of the front wing is typical of *Chimarra* and also lacks a sharp angulation and knot at the fork of R_s. This knot is typical of species such as *obscura* (Walker); of the species known from New York it is absent only in *aterrima*.

I am tentatively considering both *Curgia* Walker and *Cabreraia* Enderlein as subgenera of *Chimarra*.

Chimarra perigua n. sp.

This species is a close relative of *socia* (Hagen), and will run to it in recent keys. It differs in the more expanded apex of the clasper and

the hooked inner rods of the aedeagus, fig. 7. In *socia*, fig. 6, the apex of the clasper is much more slender, and the inner pair of rods of the aedeagus are elongate and gently sinuate.

Male.—Length 7 mm. Color of body and appendages dark brown, almost black, the front legs and the portion of the middle and hind legs beyond the femora creamy white with the spurs brown. General structure typical for genus. Genitalia in general proportions similar to those of *socia*. Ninth segment narrow and sinuate, bearing a short, spatulate ventral process on the meson. Clasper elongate, fig. 7A, from posterior view having a broad base, a slender central portion, and an expanded apex curved mesad. Aedeagus with apex tubular, fig. 7, and bearing two pairs of sclerotized rods which evert dorsad, a short, stout pair that curve sharply laterad to form a stout hook, and a long, straight, slender pair.

Female.—Length 8 mm. Color and general structure as for male Genitalia having ninth tergite constricted near apex to form a short apical collar; this character differentiates *perigua* from all other eastern members of the genus except *socia*, and from this species no satisfactory differences have yet been found.

Holotype, male.—Santa Fe River, Alachua Co., Florida, April 6, 1940, L. Berner. *Allotype*, female.—Santa Fe River at Poe Springs, Alachua Co., Florida, March 12, 1938, L. Berner. *Paratypes.*—Florida: same data as for allotype, 1 ♂. Georgia: Spring Creek, Decatur Co., August 20, 1946, P. W. Fattig, 2 ♂, 28 ♀. Echenonee Creek, Macon, May 5, 1939, P. W. Fattig. Illinois: Momence, along Kankakee River, May 26, 1936, H. H. Ross, 2 ♂; June 1, 1937, B. D. Burks, 1 ♂; September 7, Frison & Ross, 1 ♂.

The above records of this species collected from 1936 to 1940 were originally recorded erroneously as *Chimarra socia* in the "Trichoptera of Illinois" (Ross, 1944), and *socia* should be deleted as being recorded from Florida, Georgia, and Illinois. Re-examination of large series of *socia* shows that other records of *socia* given in that paper stand, thus indicating a wide eastern and northeastern range for *socia* and a small range for *perigua* which is peripheral on the southern and western portions of the range of *socia*.

Chimarra dentosa n. sp.

The sinuate ninth segment, the reduced nature of the ninth tergal region, and the triangular clasper place this species in the *aterrima* group, within which it seems most closely related to *angustipennis* Banks. From this species, *dentosa* differs in the slender dorsal projection of the clasper and the beaklike apex of the tenth tergite, fig. 8. From *ridleyi* Denning, another close relative, *dentosa* differs most conspicuously in the shape of the tenth tergite and the presence of sclerotized ridges on the mesal face of the clasper.

Male.—Length 6 mm. Color of body and appendages medium brown, the venter and legs lighter, shading to yellowish. General structure typical for genus. Genitalia as in fig. 8. Ninth segment sinuate, the dorsal portion semimembranous and merging imperceptibly with the tenth tergite, armed ventrad with a large, stout,

pointed process. Cerci small, round, and almost without a basal stalk. Tenth tergite chiefly membranous, with a small basal flange just below and in front of cercus, and with the apico-lateral lobes beaklike and only moderately sclerotized. Clasper more or less triangular from lateral view, the dorsal portion forming a long, slender finger, the postero-ventral angle projecting only slightly, and the ventral margin arcuate; the mesal face of the clasper, fig. 8A, bears a series of sclerotized ridges running from top to bottom, the upper two ridges low and looking like a knife edge from posterior view, the lower ridge short but more projecting and cusplike; the position of these ridges from lateral view is shown by broken hatching in figs. 8 and 8A. Aedeagus semimembranous and tubular, enlarged slightly at apex and flared at base; internally there are three sharp slender rods.

Holotype, male.—Apatzingan, Michoacan, Mexico, elevation 1200 feet, Aug. 12, 1941, H. Hoogstraal. *Paratypes*.—Same data, 11 ♂.

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Betten, Cornelius, and **Martin, E. Moseley.** 1940. The Francis Walker types of Trichoptera in the British Museum. 248 pp., 122 figs. London.

Ross, Herbert H. 1938. Descriptions of nearctic caddis flies. Ill. Nat. Hist. Surv. Bull. 21 (4): 101–83. 123 figs.

1944. The caddis flies of Illinois. Ill. Nat. Hist. Surv. Bull. 23 (1): 1–326. 961 figs.

CATALOGUS HESPERIDARUM REI PUBLICAE COLOMBIANAE, by KENNETH J. HAYWARD. Acta Zoologica Lilloana of the Instituto Miguel Lillo, Vol. IV, pages 201–392, 1947.

During the past five years several catalogues of the skippers of South American countries have appeared, namely, for Ecuador by Roswell C. Williams, Jr., and Kenneth J. Hayward; for Venezuela by E. L. Bell, and the title mentioned above. While it would be desirable to have a catalogue of the species of the entire continent the difficulty of the group and the constant addition of new names are obstacles which can be overcome only by long and careful study. The excellent work of Bell and Hayward continues to advance our knowledge of the skipper fauna but it is obvious that much remains to be done. Under these conditions the regional catalogues are tremendously helpful.

Like those previously published, this catalogue has an excellent and practical format. Taxonomic categories and species are printed as bold-face headings. Synonymy of the categories with original references clarifies the status of names. Under species the synonymy with references for original descriptions is supplemented by additional references including notation of illustrations of the insects and their genitalia. This compilation of material will be of inestimable value to those who have had to struggle with the widely scattered literature of the group.—A. W. L.

DESCRIPTION OF A NEW TIGER BEETLE FROM TEXAS

JOHN H. ROBINSON,
Shreveport, Louisiana

There has always been a noticeable correlation between the color patterns of some tiger beetles and their habitats. For example, *C. lepida* Dejean prefers white sand, as does *C. saulcyi* Guérin. *C. formosa* Say, on the other hand, is usually encountered on red sand and red clay. *C. belfragei* Sallé frequents black loamy ground, while *C. vulturina* LeConte is most common in burnt-over brush and on black dirt roads.

For this reason it seemed to be of especial ecological interest to discover an apparently new variety of *C. repanda* Dejean in a field consisting largely of black loam, a type of habitat where this species is not usually found.

In general appearance this specimen is narrower than the typical *repanda*, with the sides of the elytra more nearly parallel. Presented below is a table indicating the notable differences between the typical *repanda* and its varietal form *maehleri*.

Cicindela repanda Dejean

Color:

elytra bronzed, foveae green; thorax bronzed, alutaceous, broader at apex, as wide as long; humeral umbone distinct; femora, tibiae and tarsi bronzed; antennae bronzed; under surface bronze, green and blue.

Average length: 12–14 mm.

Average width: 5–6 mm.

Cicindela repanda maehleri var. nov.

Color:

elytra dull black, foveae entirely lacking, in their stead are slightly raised surfaces; thorax dull black, alutaceous, parallel, longer than wide; humeral umbone barely in evidence; femora black, tibiae and tarsi ferrugineous, antennae piceous; under surface opaque black.

Length: 11 mm.

Width: 4 mm.

Holotype: male, in author's collection (Brazos County, Texas, IV–13–35). The taxonomist must bear in mind that one frequently finds small specimens of *C. repanda* Dejean which are blackish in appearance. After examination of several hundred specimens, however, the writer found them all to possess the definite metallic bronzed lustre common to most species of this genus.

It is with great respect that this *varietas novum* is dedicated to Mr. Kenneth L. Maehler of Berkley, California, a true, ardent and capable entomologist.

CHREMYLUS RUBIGINOSUS (NEES.), A BRACONID PARASITE OF THE CASEMAKING CLOTHES MOTH

HORATIO C. MASON,[1]
Bureau of Entomology and Plant Quarantine,
Agricultural Research Administration,
United States Department of Agriculture

In October, 1931, several specimens of the hymenopterous parasite of the family Braconidae were taken by the writer from larvae of the casemaking clothes moth, *Tinea pellionella* (L.), that were collected from a wool warehouse in Columbus, Ohio. The parasites were identified by C. F. W. Muesebeck, of the Bureau of Entomology and Plant Quarantine, as *Chremylus rubiginosus* (Nees.).

Since little has been published on this parasite, it is believed that the data collected may be of interest.

Some of the investigations on the effect of temperature and relative humidity on the biology of the parasite were conducted in control cabinets that were being used for studies of another insect. Therefore it was not always possible to maintain the temperature and relative humidity at a point most desired for the study of this parasite.

HOST RELATIONS

According to Marshall (3, pp. 76, 77), Curtis reports *Chremylus rubiginosus* (Nees.) as being a frequent parasite of *Bruchus rufimanus* Boh.; Rondani bred it from *Bruchus seminarius* L.; Taschenberg lists it as a parasite of *B. granarius* Sch.; and Brischke had bred it from cases of *Tinea pellionella* L. Teichmann and Andres (4) report it as being a parasite of *Calandra granaria* L. (now *Sitophilus granarius* (L.)). Curtis (1, p. 365) frequently found it with *B. granarius* and states: "It is also serviceable in destroying wood-boring beetles which infest our houses."

Additional host records cited in literature, according to records in the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, are as follows: *Sitophilus oryza* (L.), *Tinea granella* L., *Ephestia kuehniella* Zell., *Bruchus lentis* Froel., *Bruchus atomarius* (L.), *Ernobius abietis* (F.), *Ernobius angusticollis* Rtzb., *Ernobius longicornis* Sturm., and *Ernobius mollis* (L.). All the records are apparently European.

The authenticity of some of the host records may be questionable, as a few records show no indication of the parasites being reared from isolated material.

[1]Acknowledgments are due to the following members of the Bureau of Entomology and Plant Quarantine: B. J. Landis, for many helpful suggestions and for the drawing of the adult; N. F. Howard, for helpful suggestions; and to R. W. Brubaker, G. V. Johnson, and J. W. Apple, for assistance rendered from time to time. Thanks are also due to Alvah Peterson, of Ohio State University. Many of the data were obtained while the writer was doing graduate work at this University.

SYNONYMY

Synonymy has been published by Dalla Torre (2).

DESCRIPTION OF STAGES

ADULT
(Fig. 1)[2]

"*Female.*—Length about 2 mm. Head narrower than thorax, less than one and one-half times as broad as long; face much broader than long, face, frons, and vertex rugulose punctate; temple strongly convex, nearly as broad as eye; antennae 12-segmented, about as long as head

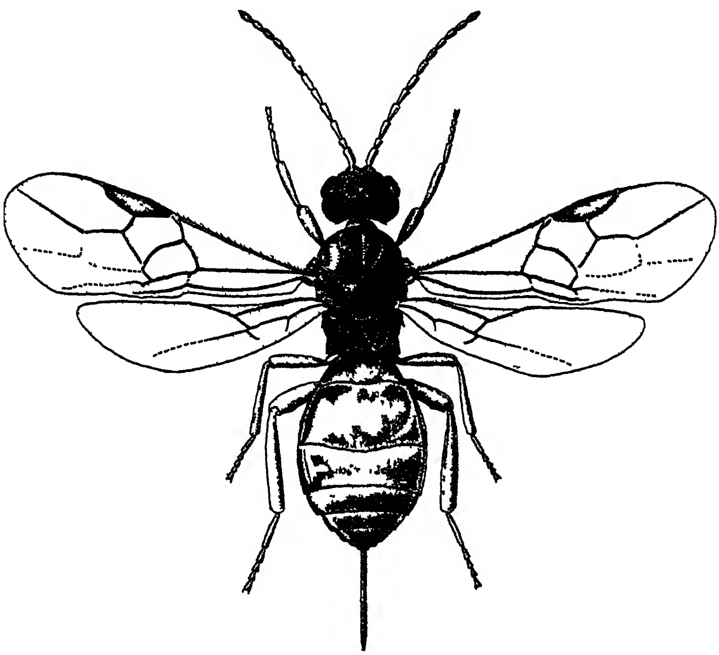

FIG. 1. Adult parasite, *Chremylus rubiginosus* (Nees.). Approximately 23×.

and thorax combined; occiput completely sharply margined. Thorax slightly broader than high; mesoscutum rather flat; notaulices complete, fine, not foveolate, middle lobe with a median longitudinal impression posteriorly; middle and lateral lobes coriaceous, the lateral ones more weakly so than the middle lobe; scutellar furrow very broad, coarsely foveate; scutellum flat, nearly smooth (only faintly reticulate); propodeum rugose, areolated, the diamond-shaped median area extending from near base to extreme apex and provided with transverse rugae;

[2]The descriptions of the adult (male and female) were supplied by C. F. W. Muesebeck in a letter to the author.

mesopleuron mostly smooth, with some rugosity anteriorly above and a short, longitudinal, foveolate furrow below; metapleuron rugose; first abscissa of radius as long as width of stigma; recurrent vein interstitial or entering base of second cubital cell; nervulus strongly postfurcal; cubitus obsolescent apically; radial cell extending to extreme apex of wing; second cubital cell, measured on cubitus, nearly or quite as long as third; submediellan cell less than half as long as mediellan; radiella wanting; calcaria of posterior tibia very short; posterior tarsus shorter than tibia. Abdomen broader than thorax, depressed, broadly sessile; first tergite much broader at apex than long, finely granular and with two prominent dorsal longitudinal keels delimiting a parallel-sided median area; suturiform articulation not indicated, the large connate second and third tergites largely finely reticulate or coriaceous, smooth laterally and along posterior margin; the following tergites smooth and polished. Ovipositor sheath about half as long as abdomen.

FIG. 2. Nearly full-grown larvae of *Chremylus rubiginosus* with remains of host. Approximately 10X.

"Brown; vertex and occiput black; thorax more or less piceous; legs including coxae brownish yellow; wings hyaline, stigma dark brown."

"*Male.*—Essentially like the female, but more weakly sculptured, especially on vertex of head and on abdomen."

Egg.—The eggs vary somewhat in shape, but in general are slightly curved, larger and more rounded at the cephalic than at the caudal end. The shell has a smooth appearance to the naked eye, but under a microscope appears to be slightly pebbled. When first laid the eggs are glossy, pearly white, and slightly translucent. As incubation progresses, they clear until, prior to hatching, examination under a binocular often reveals the outline of the embryo inside, and slight movement may be detected.

Measurements made on 105 individuals showed a variation in size

ranging from 0.40 to 0.51 mm. in length and from 0.08 to 0.13 mm. in width at the widest part, the average length being 0.45 mm. and the average width 0.11 mm. If any change in size occurs during incubation, there is a slight decrease.

Larva.—The body of the newly hatched larva is larger and more blunt on the anterior end, gradually tapering toward the posterior end. As development progresses the larva thickens through the center, tapering toward both ends. The nearly full-grown larva appears somewhat elliptical in shape when viewed dorsally and crescent in shape when viewed laterally, with distinct ridges extending over several of the middle body segments in a plane perpendicular to the long axis of the body (fig. 2).

In color the larva ranges from crystal-like appearance when newly hatched, through an off-white to a rather deep caramel shade in some larvae in the late instars. All stages are more or less translucent.

The body is composed of 13 segments and a head, with antennae present on all instars. Light flakelike areas are soon evident in the body of the young larva, becoming prominent in the late instars. The fifth, or last, instar is thickly covered with spines on all segments except the head and caudal segment.

The entire larval period of five instars is spent externally on the host. Normally there is only a slight change in location during the greater part of development.

The average dimensions of the larvae measured are shown in Table I.

TABLE I

AVERAGE DIMENSIONS OF DIFFERENT LARVAL INSTARS OF *Chremylus rubiginosus*

INSTAR	EARLY			LATE		
	Individuals	Average Length	Average Width	Individuals	Average Length	Average Width
	Number	*Mm.*	*Mm.*	*Number*	*Mm.*	*Mm.*
First	62	0.42	0.11	43	0.52	0.15
Second	48	.58	.18	30	.69	.22
Third	46	.79	.25	23	.94	.30
Fourth	42	1.03	.32	35	1.25	.39
Fifth	42	1.49	.48	42	2.44	.74

Prepupa and pupa.—After spinning its cocoon, the larva gradually changes in form, taking on that of the pupa in 4 to 6 days, depending on the temperature. Measurements made on 26 prepupae showed the average length to be 2.17 mm. and the average width 0.70 mm. at the greatest extremity.

The new pupa is white, the body tissue having a fresh, glossy appearance, with the thinner portions of the body translucent. The compound eye and ocelli range from a light purple to almost black. The appendages are closely folded against the body. As development progresses the body darkens until the characteristic adult color is assumed.

The average length of the 33 females measured was found to be 2.15 mm., less the ovipositor, which extends beyond the body approximately 0.28 mm. and upward at an angle of about 45 degrees. The average width at the widest portion was 0.76 mm. The males, in general, are considerably smaller. The 7 measured had an average length of 1.61 mm. and an average width of 0.55 mm.

Cocoons.—The parasite larva spins up inside the case of the host in an individual whitish, silken cocoon, somewhat elliptical in shape and like tissue paper in structure. Measurements made on 47 cocoons gave an average length of 2.84 mm. and an average width of 0.97 mm. The thin walls, which are easily torn with a sharp instrument such as a dissecting needle, often permit the outline of the pupa to be seen inside. When several parasites are found on a host, the cocoons are stuck together in a cluster (fig. 3), with the dried and shriveled remains of the host often crowded to one end of its case.

FIG. 3. Cocoons of *Chremylus rubiginosus* stuck together in a cluster. Approximately 8×.

The adult in emerging cuts through the thin wall of the cocoon with its mandibles at or near one end, and gradually works its way out head first, leaving the waste material and cast skin behind.

REARING METHOD

Chremylus rubiginosus has been reared with no difficulty on larvae of the casemaking clothes moth, *Tinea pellionella* that ranged in size from less than half grown to practically mature.

Cardboard pillboxes approximately 1⅝ inches in diameter were used for rearing cages. To permit ventilation, a hole approximately ⅝ inch in diameter was cut in both the top and the bottom of the box. Cheesecloth attached over the holes prevented the insects from escaping.

Clothes moth larvae, usually not more than 15 or 20, were placed in each pillbox, together with a small piece of raw wool or rabbit fur. From 5 to 15 female parasites were then introduced for the exposure. The hosts were normally exposed for about 24 hours, except where more detailed studies were being made on biology.

Examinations for the eggs were made by slitting the host case along one side and, by means of two insect pins, carefully opening it under a binocular. If the larva inside was found to be paralyzed, a thorough search was made for eggs, both on the body of the host and in the case. If eggs were present and the studies required only one parasite on a host, all eggs but one were removed. This was easily accomplished, as the eggs readily adhere to an insect pin. Any extra eggs were transferred to larvae that were paralyzed but on which no eggs had yet been deposited.

It was found advisable to keep the case of the parasitized larva closed between examinations. This was accomplished by means of a paper collar made by cutting a slit in a piece of tissue paper approximately 10 mm. square. The host case was inserted in the opening and drawn about half way through, a snug fit being essential. If the case was permitted to gap open, the parasite larvae, when nearly mature, would often work their way out into the pillbox, where they seldom developed normally. Where cases had been slit for examination, unparasitized host larvae would often mend them in a few hours.

In a few tests gelatin capsules (No. 3) were used to confine the host after parasitization. The larva was removed from its case and placed in the capsule. This permitted observations to be made at will, without disturbing either parasite or host. Two or three small holes punched in one end of each capsule with an insect pin permitted ventilation.

Although rearing was done on only a small scale, the writer believes that this parasite can be reared on a large scale with little or no difficulty.

LIFE-HISTORY STUDIES

Total development.—Studies were conducted to determine the effect of temperature and relative humidity on the total development of *Chremylus rubiginosus*. In most tests the host was exposed to the parasites for 24 hours in pillboxes of the type described above. The parasitized larvae were not always held for parasite development at the same temperature and relative humidity as those under which the exposures were made. Examinations for emergence were made at 24-hour intervals.

Total development was considered to be the period from the end of the host's exposure to the parasite to the emergence of the new parasites from the case of the host.

In test *A* the parasites were held for development in a constant-temperature cabinet operated at an average temperature of 81° F. and 61 per cent relative humidity. A total of 185 adults emerged, 51 males and 134 females. On an average 19.0 days were required for the males to develop, 18.4 days for the females, and 18.6 days for all individuals.

In test B the parasites were held in a constant-temperature cabinet operated at an average temperature of 81° F. and 43 per cent relative humidity. In this cabinet the relative humidity was 60 per cent for a few days before leveling off to 40 per cent, at which the cabinet was then operated. A total of 213 individuals emerged, 38 males and 175 females. On an average 22.0 days were required for the males, 20.9 days for the females, and 21.1 days for all.

In test *C* studies were conducted in a constant-temperature cabinet operated at an average temperature of 71° F. and an average relative humidity of 61 per cent. In this test 180 adults emerged, 86 males and 94 females. On an average, 29.1 days were required for the males, 28.9 days for the females, and 29.0 days for all.

In test *D* 235 parasites emerged, 41 males and 194 females. These data were collected during the winter, and the parasites were held for development in the basement of the laboratory. The fluctuation in temperature and relative humidity was not great. The average temperature for the period was 67° F. and the average relative humidity 38 per cent. On an average 31.7 days were required for the males to develop, 31.0 days for the females, and 31.1 days for all individuals.

Under conditions of test *E*, 194 parasites emerged, 92 males and 102 females. These parasites were held for development at room temperature during the winter, when the building was artificially heated. There was considerable variation in temperature and relative humidity. The relative humidity at times ran quite low. On an average 29.5 days were required for the males to develop, 28.9 days for the females, and 29.2 days for all.

In test *F* approximately 155 larvae of *Tinea pellionella* were exposed for parasitization, either at room temperature or in one of the above-mentioned cabinets. After exposure they were held for parasite development in an electric refrigerator operated at an average temperature of approximately 53° F. The relative humidity was high, but the per cent is not known. No emergence occurred from the parasitized material while it was being held in the refrigerator. After approximately 105 days, part of the material was removed from the refrigerator and stored at room temperature. When examined a few days later, two female parasites were found, emergence having occurred after the material was removed. The remainder of the material was removed from the refrigerator after approximately 165 days and held in the basement of the laboratory. When examined a few days later, 4 males had emerged. No further emergence occurred from either lot. Since it is not uncommon for 4 or more parasites to emerge from one host, the emergence from the larvae held in the refrigerator was extremely low.

When the data were analyzed, the differences in the length of development between the two sexes was found to be highly significant in tests *A* and *B*, the males requiring the greater length of time. In tests *C*, *D*, and *E* the differences were not significant, but in all tests the trend was for a longer period of development with the males.

The differences in the length of time required for total development under the conditions described were found to be highly significant in all cases except in comparison between *C* and *E*. Comparisons were not made in test *F*, because of the small number of parasites that emerged. Total numbers were used for the comparisons.

In tests *A* and *B*, where the average temperature was the same but the average per cent relative humidity was different, the average time required for development was less at the higher relative humidity. In tests *A* and *C*, where the per cent relative humidity was the same but the temperature was different, development was considerably faster at the higher temperatures.

Development by stages.—Studies were conducted on length of the developmental period for the different stages of the parasite. Only one parasitized larva was held in each pillbox and only one parasite was permitted to develop on each host. Examinations were made three or four times daily at slightly lower temperatures than those at which the parasites were held for development. This may have resulted in lengthening the developmental period somewhat, although only a few minutes were required for each examination.

The incubation period was considered to be the interval from the time the egg was found until the hatch was observed; the larval period from the time of hatch until the larva was observed spun up; and the prepupal and pupal period from the time the larva spun its cocoon until the adult emerged.

In test *A* the parasites were held for development in a constant-temperature cabinet operated at an average temperature of 81° F. and 79 per cent relative humidity. The incubation period for 106 eggs averaged 1.4 days; the larval period for 37 individuals averaged 4.5 days; and the prepupal and pupal period for 24 individuals averaged 11.6 days. The period of time required for total development was the same for both males and females, being 17.4 days for the 33 adults that emerged.

When the time required for total development in this test is compared with that for *A* and *B* in the preceding test, the data again reveal that development was faster when the relative humidity was higher.

In test *B* studies were made to determine the time of development for the five larval stages. The parasites were held in a room where the temperature and relative humidity were not controlled. The temperature for the period averaged 74° F. and the relative humidity averaged 47 per cent. Examinations were made three times daily. To determine what effect frequent examinations would have on development, parasitized larvae were held under the conditions just described but the host cases were not slit open and the material was not disturbed by frequent examinations.

To find out when the parasite larvae molted, they were marked with a tiny speck of dry lampblack, which made it easy to determine when the larval skin was shed.

The incubation period for 93 eggs averaged 2.1 days. The average developmental period for the five larval stages was as follows: First, 0.9 day for 63 individuals; second, 0.6 day for 59 individuals; third, 0.5 day for 56 individuals; fourth, 0.7 day for 52 individuals, and fifth, 2.9 days for 45 individuals. The prepupal and pupal period required 16.2 days for 40 individuals. The total developmental period for the 47 adults (8 males and 39 females) averaged 23.7 days. The 39 females averaged 23.6 days and the 8 males 24.6 days.

From the check or undisturbed material, 58 males and 145 females emerged. The males required on an average 22.2 days for total development, and the females 22.6 days. For the total number of 203 adults 22.4 days were required. The data show that an average of 1 day less was required for development of the females in the check than in the material disturbed by frequent examination. This difference was found to be highly significant. Females were used for the comparison because of the small number of males that emerged in this test.

OVIPOSITION

Parasitization normally takes place with the host larva in its case (fig. 4), however, an occasional parasitized larva has been found out of its case. It is believed that the larva is generally paralyzed prior to oviposition as numerous larvae have been found paralyzed in their cases without eggs being present, although in one instance a larva was observed out of its case, crawling about with one egg attached to its body. With the exception of being inactive or practically so, paralyzed larvae appear quite normal for several days before they start to turn dark in color. In a few instances eggs have been found only partially inserted through the wall of the case, but normally they are deposited either on the external surface of the body of the host or on the inside of the case. Eggs have been found scattered all over the body of the host larva, either singly or in clusters of two or more.

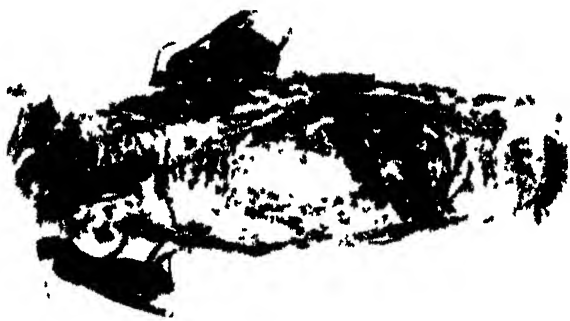

FIG. 4. Adults of *Chremylus rubiginosus* on a case of *Tinea pellionella* attempting oviposition. Approximately 9×.

Studies were conducted to determine the number of eggs individual female parasites would lay. The females were taken within a few hours after emergence and were placed in pillboxes in a constant-temperature cabinet. One female was placed in each box with a case-making clothes moth larva that was half grown or larger. Some of the females were paired with males. A raisin stuck on a pin in each box served as a source of food for the parasites. The host larvae were exposed to the parasites for 24 hours before they were examined for eggs. The host case was slit open along one side, as previously described, so that the case could be opened and the larva removed for examination under a binocular. Any eggs found in the case or on the host were counted and the number was recorded. After the examination the larva was returned to its case, if it had been removed, and the case was closed and held shut by means of the tissue-paper collar. If eggs were found a new larva was exposed, but if no eggs were present the larva was re-exposed. If found to be only paralyzed, it was again exposed, but was replaced with another larva at the end of 24 hours, regardless of whether oviposition had taken place.

In test *A* oviposition records were taken on 50 females that were held in a constant-temperature cabinet operated at an average temperature of 71° F. and an average relative humidity of 55 per cent. Any female that had at any time been exposed to a male was considered mated. Twenty-five of the females were mated, 23 were unmated, and the status of 2 was unknown. The maximum number of eggs laid by any mated female during her life was 27 and by any unmated female was 33, with a minimum of 0 in both cases. The average number of eggs for the 50 females was 15.8. The maximum number of eggs laid by any female in one day was 9 for the mated, and 7 for the unmated, with an average for all individuals of 1.5 eggs per day. The length of life for the mated females ranged from 7 to 14 days and for the unmated females from 4 to 20 days, with an average of 10.3 days for all individuals.

In test *B* data were obtained on 48 females, 29 mated and 19 unmated, that were held in a constant-temperature cabinet operated at an average temperature of 89° F. and an average relative humidity of 41 per cent. The maximum number of eggs laid during the life of any female was 30 for the mated and 21 for the unmated, with an average for all females of 11.2. The minimum number of eggs laid in both cases was 0. The maximum number of eggs oviposited by any female in 1 day was 10 for the mated and 9 for the unmated, with an average of 1.7 eggs per day for the 48 females. The mated females lived from 1 to 10 days and the unmated from 4 to 10 days, with an average of 6.6 days for all the females.

The average number of eggs laid per female during her life period was slightly higher with the mated females in tests both *A* and *B*, although the differences were not great enough to be significant. There was no significant difference in the average length of life between the mated and unmated in either test. The average length of life was longer and the average number of eggs laid per individual was greater with the females held under the conditions of *A*, the differences being highly significant.

LONGEVITY OF ADULTS

Studies were conducted to show the effect of different conditions of temperature and relative humidity on the length of life of adult parasites. The parasites were taken within 24 hours after emergence and were placed in ventilated pillboxes, with a raisin stuck on a pin for food. Examinations were made at 24-hour intervals and the results recorded. Females used for these studies were not used for oviposition purposes.

In test *A* the results were recorded on 81 adults, 31 males and 50 females, that were held in a constant-temperature cabinet at an average temperature of 81° F. and 61 per cent average relative humidity. The average length of life for the males was 8.0 days, for the females 11.4 days, and for all individuals 10.1 days. The maximum length of life of any male was 16.0 days and of any female 22.0 days.

In test *B* the data were taken on 190 adults, 82 males and 108 females, held in a constant-temperature cabinet at an average temperature of 72° F. and an average relative humidity of 59 per cent. The average length of life for the males was 9.7 days, for the females 13.8

days, and for all individuals 12.1 days. The maximum length of life for any one male was 26 0 days and of any female 34.0 days.

In test *C*, data are shown on 106 parasites, 12 males and 94 females, held in an electric refrigerator at an average temperature of 50° F. The average relative humidity was estimated at 60 per cent or higher. The average length of life for the males was 13 9 days, for the females 71.7 days, and for all individuals 65.2 days. The maximum length of life for any one male was 22.0 days and for any one female 137.0 days.

Under all three sets of conditions the average length of life for the females was longer than for the males, the differences being highly significant. As will be noted, the parasites lived longer at the lower temperatures.

MATING

Chremylus rubiginosus mated readily in confinement. On one occasion the case of a parasitized larva of *Tinea pellionella* was opened for examination. Seven females and one male parasite emerged. They were placed in a pillbox together, where they mated immediately.

On another occasion when two males were placed in a vial with five females, all of which had emerged a few hours previously, mating soon followed. The females gathered about the males with their ovipositors elevated at an angle of about 35 degrees. The males went from one female to another copulating.

SEX RATIO

From a sample of 979 adults, which were the progeny of females that had been confined with males, 79 per cent were females and 21 per cent were males.

PARTHENOGENESIS

The eggs from unmated females of *Chremylus rubiginosus* were viable, but in all observed cases only male progeny were produced.

SUPERPARASITISM

Superparasitism does occur with this parasite (fig. 5). As many as 30 eggs of *Chremylus rubiginosus* have been found on one larva of the casemaking clothes moth, and 21 large parasite larvae have been found on one host. It was not uncommon for 6 or 7 adult parasites to emerge from the case of a single host.

REARING OF TINEA PELLIONELLA

For several years abundant host material was successfully maintained with very little labor. Cultures were easily started by introducing adults of *Tinea pellionella* into cylindrical cardboard Rolled Oats boxes containing raw rabbit fur. When environmental conditions were favorable, the moths oviposited freely and the larvae made a vigorous growth. The same cultures were maintained by the writer for approximately 2 years by adding food as needed. If the cultures are permitted to run too long, considerable waste material accumulates in the bottom of the container, unless such material is removed from time to time.

During the winter months the cultures were held in a laboratory room where the temperatures ranged from 70° to 80° F. and the relative humidity from 40 to 45 per cent. During the summer months the cultures were held in the basement, where the temperature was seldom higher than 75° and where there was sufficient ventilation to prevent mold from forming.

As rearing media, pheasant feathers and raw sheep's wool were used with success, but the writer obtained the best results with raw rabbit fur as a medium.

FIG. 5. Nearly full-grown larvae of *Chremylus rubiginosus* in opened case of *Tinea pellionella*. Approximately 8×.

SUMMARY

Chremylus rubiginosus (Nees.) is a small braconid parasite of the larva of the casemaking clothes moth, *Tinea pellionella* (L.). It was taken from moth larvae collected from a wool warehouse in Columbus, Ohio, in 1931. Several hosts are recorded for this parasite, but all records are apparently European.

The eggs of *Chremylus rubiginosus* measure approximately 0.45 mm. long by 0.11 mm. wide through the thickest portion. The larvae pass through five instars, ranging in size from approximately 0.42 mm. by 0.11 mm. as an early first instar, to 2.44 mm. by 0.74 mm. as a late fifth instar. Before transforming to a pupa, the larva spins up in an individual silken cocoon inside the case of the host. The pupa of the female measures approximately 2.15 mm. long, less the ovipositor, by 0.76 mm. wide through the widest portion. The male pupa is considerably smaller.

In a laboratory room where the average temperature was 74° F. and the relative humidity 47 per cent, 2.1 days were required for incubation of the eggs, 0.9 day for the first larval stage, 0.6 day for the second, 0.5 day for the third, 0.7 day for the fourth, 2.9 days for the fifth, and 16.2 days for the prepupal and pupal periods. Total development for the 39 females and 8 males required 23.6 and 24.6 days, respectively.

Data on total development as influenced by other conditions of temperature and relative humidity are listed in the text. At the same temperature, the time required for development decreased as the relative humidity increased. At the same relative humidity development was faster at higher temperatures. The males usually developed more slowly than the females.

Oviposition records on 50 females held at an average temperature of 71° F. and 55 per cent relative humidity showed that an average of 15.8 eggs were laid by each female during her life. At 89° and 41 per cent relative humidity, data on 48 females show that 11.2 eggs were laid by each female.

Under the conditions of the tests, the average length of life of the females was greater than that of the males. In a constant-temperature cabinet, where the temperature averaged 81° F. and the relative humidity 61 per cent, the average length of life of 31 males was 8.0 days and of 50 females 11.4 days. At 72° and 59 per cent relative humidity, 82 males lived 9.7 days and 108 females 13.8 days. At 50° 12 males lived 13.9 days and 94 females 71.7 days.

Records on a sample of 979 adults showed that 79 per cent were females and 21 per cent were males.

Eggs from unfertilized females produced only male progeny.

Superparasitism occurs with *C. rubiginosus*. As many as 30 eggs were found on a single host, and 21 large parasite larvae were found in a single host case.

Cultures of the casemaking clothes moth have been reared on raw rabbit fur and pheasant feathers.

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These three articles continue Hayward's long series of reports on the skipper fauna of the Argentine. They include chiefly new records for the area and corrections of previous records. No new species are described but descriptions of the allotype female of *Astraptes fulgor* Hayward and the allotype male of *Lerodea gisparoides* Hayward and figures of the male genitalia of *Pellicia extensa* Mab. and *Erynnis austerus* Schaus are included. The notes on synonymy are important.—A. W. L.

CONTRIBUTION OF THE UNITED STATES NAVAL MEDICAL SCHOOL TO ZOOLOGICAL SCIENCE IN WORLD WAR II

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The chief mission of the United States Naval Medical School in peacetime has been the training of men of the Navy "for service ashore and afloat with special emphasis upon certain phases and branches of medicine and surgery of particular importance and peculiar to the Navy."[1] During the war just past, the primary function of the Naval Medical School was the training of personnel "in various specialties of timely importance incident to the war and to its geographical theaters of operation."[2] High on the list of these specialties were malariology, epidemiology, and tropical medicine.

Most of the men who made up the Navy malaria control units and epidemiology teams that were sent into the Atlantic and Pacific areas during the recent war attended the United States Naval Medical School, Bethesda, Maryland. A great number of them had been procured from ranks of civilian entomologists, parasitologists, and bacteriologists; from the Bureau of Entomology and Plant Quarantine, from the Fish and Wildlife Service, and from numerous colleges and universities. A considerable number of physicians gave up their private practices of medicine to head up these preventive medicine teams. They functioned in every continent and many of them participated in the insular invasions. Of the total of 801 officers and 1,711 enlisted personnel, belonging either to the Medical Corps or to the Hospital Corps of the Navy, who received training in Tropical Medicine at the Naval Medical School during the years 1942 to 1946, 223 officers and 656 enlisted men completed courses in parasitology and medical entomology leading to certificates in malariology, and 186 officers and 382 enlisted men attended the organized course in epidemiology.

In World War II, with the wide dispersal of these specialists trained in the field of biology and kindred sciences among the men of the United States Navy in the farflung corners of the earth, an unusual opportunity presented itself for the collection of valuable data and material for use in scientific study and research in the less turbulent days to follow. The malariologists and epidemiologists were trained primarily to join combat units or to take over malaria control at advanced bases. Some engaged in hazardous surveys prior to invasion, while others going in with the first and second waves were instrumental in making beachheads tenable. Frequently, many were called upon to initiate plague studies (Hawaii and South Pacific), to institute control measures for the vectors of typhus (Mediterranean area), to reduce the incidence of dengue

[1]Pugh, H. L., Rear Admiral (MC) USN, U. S. Naval Medical Bulletin 46(8) :1160, August, 1946.

[2]Ibid.

(Central Pacific islands), to recommend control of filariasis (Pacific area), and to carry on rigorous campaigns against mite-borne typhus (New Guinea and the Philippines). Part of their training was to make surveys, both of the diseases and of the vectors. If time permitted, they were urged to make more detailed studies of local problems and to complete surveys of the insect, mammalian, or other faunae. These sources of information made possible the development of more efficient and scientific control programs of the diseases and vectors involved, not only from the entomological angle but from a broad zoological aspect, and yielded an abundance of valuable material, including species new to science and specimens rare to museum collections. Material was obtained from many areas in the Pacific where collections had never before been made, especially in the Japanese Mandated Islands.

Early in the war, the Naval Medical School recognized the importance of maintaining a representative collection of insects of medical importance, and continuous efforts were made to add to this from all available sources. On August 3, 1943, the Bureau of Medicine and Surgery issued a letter to "All Ships and Stations," requesting that entomologists and malariologists collect and send to the Naval Medical School, Bethesda, Maryland, mosquito larvae and adults, in accordance with instructions provided. The cooperation of the United States National Museum was procured for identifying the specimens, both institutions appreciating the opportunity of building up a complete worldwide collection for reference and identification of unknown material, as well as an adequate collection for teaching Medical Entomology.

From December 1941 to January 1946, 157 separate lots of specimens (mainly insects) were received for examination and incorporation in the Medical School teaching and reference collections or for transfer to and identification by the various specialists of the Bureau of Entomology and Plant Quarantine and of the U. S. National Museum. These collections[3] included a total of 29,199 itemized specimens of insects (mainly mosquitoes, both larvae and adults) plus 931 miscellaneous specimens (molluscs, fishes, reptiles, birds, mammals, etc.), making a grand total of 30,130 individual specimens determined, for which identifications were returned through the Commanding Officer of the Naval Medical School to the senders in the field.

Since mosquitoes are the vectors of several important tropical diseases, particular emphasis was placed on their collection—the anophelines because of the association of certain species with the transmission of malaria and filariasis, and the culicines because among them are found the vectors of yellow fever, dengue, filiariasis, tularemia, and certain types of encephalitis.

In the genus *Anopheles*, 49 species were represented in the shipments received from 20 different localities. These included 1,036 adults and 1,126 larvae, specifically identified, and contained long series of some of the more important malarial vectors, such as *annulipes*, *farauti*, and *punctulatus* from Australia, New Guinea, and the Solomon Islands; *albitarsis* and *darlingi* from South America; *albimanus*,*aquasalis*,

[3]Shipments from Navy Medical Research Units are not included in these collections.

bellator, and *pseudopunctipennis* from Central America and the Caribbean area; *quadrimaculatus*, the common vector in the eastern United States; *labranchiae labranchiae* and *sergenti* from North Africa; *minimus flavirostris* from the Philippine Islands; *hyrcanus sinensis* from Japan; and *stephensi* from India.

Particularly representative collections of the anophelines of the respective areas were sent in from Brazil, Honduras, Nagasaki, New Guinea, New Hebrides, the Philippine Islands, and the Solomon Islands. Notes on the typical breeding and resting places of many of the species accompanied the specimens, adding materially to the information on the biology of some of the more important malaria vectors.

In the shipments of 1,693 adults and 1,100 larvae of the genus *Aedes* received at the Naval Medical School, 60 known species were included together with 11 new to science. Collections were made in 30 different localities, some of which provided new records of occurrence and distribution.

Aedes is the largest single genus of mosquitoes, containing over 500 different species. However, from the medical standpoint, it is of primary significance because it includes several species capable of transmitting important tropical diseases. The best known and most widely distributed species is the highly domestic *aegypti*, the important cosmopolitan vector of urban yellow fever of dengue. Specimens of this species were received from Borneo, Espiritu Santo, Guam, Samar, Marshall Islands, Nanumea, New Hebrides, Okinawa, Saipan, Samoa, Tinian, and southern United States. A single collection of *A. aegypti* was obtained from New Guinea (Samarai) where it was believed to have been recently imported.

The oriental species *Aedes albopictus*, known to transmit dengue in the Philippines and elsewhere in the oriental region, was received from Borneo, Hawaii, Nagasaki, Okinawa, Saipan, Tinian, and various localities in the Philippines.

Another important dengue vector represented in several shipments was *Aedes scutellaris* from New Guinea and New Hebrides. Other members of this scutellaris group were *pernotatus* from New Hebrides, Espiritu Santo, and Efate; and *quasiscutellaris* from Guadalcanal, Bougainville, and Treasury Island.

A number of specimens of *Aedes pseudoscutellaris* (diurnal biter), the principal vector of filariasis in the Samoa-Fijian area, were received from Samoa, Espiritu Santo, Nanumea and Lakena Islands. With the mosquitoes sent in from the filarial survey[4] of Samoa early in 1944, were ten slides of beautifully stained microfilariae of *Wuchereria bancrofti* and fifteen slides of microfilariae obtained by mosquito dissection, demonstrating the developmental stages from one to fourteen days. These were an unusual and valuable addition to the teaching material of the Naval Medical School. Two slides of microfilariae (*W. bancrofti*) were also received with a collection of mosquitoes from the Malaria and Epidemic Control Unit at Iheya Island (Okinawa Group), June 1945.

[4]Byrd, Elon E., Lt. H(S)USNR, St. Amant, Lyle S., Lt. (j.g.) H(S)USNR, and Bromberg, Leon, Commander, (MC)USNR, U. S. Naval Medical Bulletin 44(1):1–20. 1945.

Valuable teaching slides of the microfilariae of *W. bancrofti* and *W. malayi* were sent in from the Malaria and Epidemic Control Headquarters of the South Pacific Command at Espiritu Santo.

The new species of *Aedes*, described either by specialists in the National Museum or by Navy personnel working in cooperation with these specialists, from material sent in through the Naval Medical School were: *Aedes daggyi* Stone and Bohart, collected at Espiritu Santo, New Hebrides, by R. H. Daggy; *A. dorseyi* Knight, collected on Peleliu Island by C. K. Dorsey; *A. hensilli* Farner, collected on Ulithi Islands by George S. Hensill; *A. knighti* Stone and Bohart, collected on the Solomon Islands by W. G. Downs; *A. marshallensis* Stone and Bohart, collected on the Marshall Islands by D. A. Treat; *A. paradissimilis* Rozeboom, collected on the Philippine Islands, by J. H. Pallus; *A. paullusi* Stone and Farner, collected on Samar, Philippine Islands, by J. H. Pallus; *A. pernotatus* Farner and Bohart, collected on Espiritu Santo, New Hebrides, by K. L. Knight; *A. quasiscutellaris* Farner and Bohart (in addition to type material) from Guadalcanal, collected by A. B. Weathersby and others, and from Treasury Island, collected by J. H. Pallus; *A. saipanensis* Stone, collected on Saipan, Marianas Islands by Joseph Greenburg; and a specimen (*Stegomyia*) still undescribed.

By far the greatest number of individual specimens of mosquitoes received for identification belonged to the genus *Culex*, 4,471 adults and 3,725 larvae being transmitted to the National Museum for determination. These represented 56 separate shipments from 33 different localities, from which 72 species were identified.

The important species of the genus *Culex* from the point of view of disease transmission is the common house mosquito, *C. quinquefasciatus* (syn. *fatigans*) which is one of the known effective vectors of filariasis in certain areas. It is also a great pest in the warm temperate, tropical, and subtropical regions of the world. Both larvae and adults of this species were received from the following localities: Brazil, Espiritu Santo, Borneo, Guam, Hawaii, Honduras, Los Negros, Marcus Island, Marshall Islands, Nagasaki, Okinawa, Peleliu, Saipan, Samar, Samoa, Schouten Islands, Tinian, United States (California and Louisiana). Representative collections of other species of the genus *Culex* were received from these and other localities. New distribution records were thereby procured and specimens not hitherto represented in the Museum collection were obtained.

Numerous other new species of *Aedes*, *Anopheles*, and *Culex*, collected and described by members of NAMRU 2, are not included here.

Besides the three genera of medical importance, 1,555 adults and 952 larvae of miscellaneous culicids, representing 22 genera and 90 species, were submitted for identification. These were received in 35 separate shipments from 22 different localities. Some excellent collections added materially to the representative specimens in the National Museum from certain areas, and several species proved new to the collection: *Bironella hollandi* from Guadalcanal; *Megharinus nigripes* (male with larval and pupal exuviae, probably the first reared specimen of this species) from Tarakan, Borneo; and *Uranotaenia moultoni* also from Tarakan, Borneo.

Approximately 188 species and 86 genera were represented in the 3,080 specimens of Diptera (other than mosquitoes) sent in for identification. These were included in 27 separate shipments from 16 different localities, where in some instances extensive insect surveys had been made. Large and extensive collections were received from the Malariology and Epidemiology Control Units in Brazil, Espiritu Santo, Mariannas, Peleliu, Saipan, Southern Rhodesia, and the Transvaal. Of particular interest in these shipments were: *Diachlorus anduzei* from Brazil, previously known from Venezuela only; *Chlorotabanus mexicanus*, apparently the first Brazilian record; probably a new species of *Sarcophaga* from the Marianas; a series of larvae, pupae, and adults of *Culicoides peliliouensis* from Peleliu; a species of *Carnus* (probably new) from Saipan; five specimens of a bat parasite, *Cyclopodia inclita* (family Nycteribiidae), a Samoan species not previously reported elsewhere, from the Solomon Islands; several species of *Glossina* from Southern Rhodesia and the Transvaal, including *morsitans*, an important vector, and *brevipalpis* and *swynnertoni*, implicated in the transmission of the trypanosomes that are the causal organisms of sleeping sickness in man and "nagana" in horses and other livestock.

In addition to the large collections of Diptera, thirteen other orders of insects were represented in shipments received at the Naval Medical School and included 5 species of Anoplura, 38 of Coleoptera, 2 of Collembola, 3 of Dermaptera, 21 of Hemiptera, 4 of Homoptera, 48 of Hymenoptera, 3 of Isoptera, 2 of Lepidoptera, 16 of Mallophaga, 4 of Odonata, 29 of Orthoptera, and 10 of Siphonaptera, totalling 592 specimens in all.

Of the fourteen shipments of mites from eleven different localities, 648 specimens were identified. They included 50 genera and 60 species, six of which proved to be new to science. *Trombicula* new species (in manuscript) was collected by Navy personnel in the Philippine Islands; three new species of *Eutrombicula* (not yet described) and two new species of *Neoschongastia* (= *Paraschongastia*), *N. riversi* and *N. americanus solomonis* described by G. W. Wharton and A. B. Hardcastle, were among the trombiculid larval mites sent from Bougainville Island. A large collection made on Saipan contained 20 different genera of groups "almost unstudied" and probably most of the material is as yet undescribed, according to specialists in the group.

Only a few ticks were received for identification from three different localities—a total of 31 specimens representing five genera: *Argas*, *Amblyomma*, *Boophilus*, and *Rhipicephalus* from Brazil; *Boophilus annulatus microplus* from Guam; and two nymphs and fifteen larvae of *Ixodes* sp. contained in the ear of a rat from Freemantle, Australia.

Shipments of spiders were received from Peleliu, Agrihan, Tinian, and Parry Island. Those that were identifiable were twenty-five specimens of *Latrodectus hasselti* from Tinian and one specimen of *L. geometricus* from Parry Island with the comment that the species was abundant around the camp area.

Two scorpions, both *Hormurus australasiense*, were included in shipments from the Marianas and the Solomons. Also in the shipment from the Marianas were a few specimens of millipedes and centipedes.

Because of the prevalence of rodents on the Pacific islands and adjacent continental areas and the danger to our armed forces from the

bubonic plague and other rodent-borne diseases affecting man, rodent control was a part of the duties assigned to some of the officers given training in malariology and epidemiology at the Naval Medical School. Through their efforts, a representative collection of rodents and their ectoparasites was secured from the principal islands where control work was done and forwarded through the Naval Medical School to the National Museum.

During the early stages of the invasion of Leyte, a shipment of rodents was made from that island. A collection of rodents made in Guam embraced specimens of every form known to occur there. Among the 275 specimens of mammals (mainly rodents) received from 17 different localities, 52 species were represented.

A Navy Historical Survey of the Solomon Islands included in its collections not only a number of rodents but other mammals, birds, reptiles, molluscs, and miscellaneous arthropods. These were transmitted through the Naval Medical School to the specialists in the groups and proved in many particulars very useful and valuable additions to Museum collections. The birds from the Solomons consisted of 28 specimens representing 19 different species, and the molluscs consisted of 11 specimens representing as many different species.

As the result of a survey made early in 1945 by an epidemiology unit in Samar, a collection of molluscs yielded five different genera, including specimens of *Schistosomophora* which are the intermediate hosts for the Asiatic fluke, *Schistosoma japonicum*, in the region, and "the first reported for the Island of Samar." The total number of molluscs (preserved specimens) sent in from ten separate localities were 190 and included 76 different species. A large number of living molluscs, in connection with the study of bilharzia disease[5] (schistosomiasis) in Egypt, were sent to the National Naval Research Institute from the Epidemiology Unit in the Middle and Far East—*Planorbis boissyi* and *Bulinus truncatus*, intermediate hosts of *Schistosoma mansonia* and *S. hematobium*, respectively, from Egypt; also *Physopsis africanus*, the intermediate host of *S. hematobium*, and *Lymnaea natalensis*, the potential intermediate host of *S. japonicum*, from Natal and Southern Rhodesia.

Five collections totaling 138 specimens of reptiles, representing 28 different genera, were included in shipments from Australia, Brazil, the Marianas, and the Solomons. A very interesting survey made in 1944 by a malaria and epidemic control unit in Saipan added materially to the Museum's collection which prior to that time "had no material from this region except two examples of Lesson's skink."

Also in this collection from Saipan were 148 specimens of the western mosquito fish, *Gambusia affinis affinis*, native to the United States and one of the most widely planted fishes in the world. These were reported by the natives to have been introduced from Guam. In many places about the Island they had been planted in fish ponds, cisterns, and wells to control mosquito breeding.

A collection of balanoglossids, also included in the Saipan shipment,

[5]Amberson, Julius M., Commander (MC)USNR, U. S. Naval Medical Bulletin 46(7):977–1010. 1946.

were identified as *Ptychodera flava* and constituted a new locality record, since they had not been taken before within many hundreds of miles of Saipan.

From the foregoing summary of the material received from Navy personnel engaged primarily in malaria and epidemic control in the various theaters of operation during World War II, it would seem that a very valuable contribution has been made to zoological science.

As the United States Navy advanced into previously unoccupied areas and boundaries of geographical importance were extended, it naturally followed, for the safety and welfare of the military forces, that a better knowledge of the zoogeographical regions of the world was necessary. The rare opportunity afforded for making collections in hitherto unexplored areas, in itself, was an incentive to add materially to the scope of present knowledge on the systematics and zoogeography of various groups and to provide a stimulus for future research. But of far greater importance, the material and data thus collected were of immediate practical value in relation to the possible transmission of diseases endemic to the regions by increasing the efficiency of the occupying forces to control the vectors and reservoirs of such diseases and to establish and maintain more healthful conditions, not only for the military personnel but for the native populations as well. Thus, the mission of the Medical Department of the United States Navy was fulfilled, an objective of the Naval Medical School was attained, and a service to humanity of far-reaching consequences was rendered.

THE MOSQUITOES OF ILLINOIS, by HERBERT H. ROSS. Bulletin of the Illinois Natural History Survey, Volume 24, Article 1, 96 pages, 184 figures, 1947.

This recent publication shares the excellent format and high quality of all of the Illinois Natural History Survey publications. It should be an excellent guide to the study of the mosquitoes of the midwestern region even beyond the limits of the state.

The introductory pages include an excellent brief survey of the bionomics of the group, methods of collecting and preserving material, study and rearing. The taxonomic portion begins with a brief statement on the characteristics of the family and its major subdivisions, with a key for the separation of the Chaoborin and Culicinae in both the larval and adult stages. The remaining portion covers the subfamily Culicinae in detail. Keys to genera are based on larvae, adults and genitalia of both sexes. Under each genus the species are keyed by larval characteristics and those of the adults of both sexes, and descriptions of the immature and adult stages are given. The records of distribution for the state of Illinois are detailed. Most of the figures are of genitalia and larval structures. All are excellent.

The bulletin concludes with a bibliography of thirty-two titles and an index of scientific names.—A. W. L.

A METHOD OF FILING BUTTERFLIES FOR THE STUDY OF GEOGRAPHICAL VARIATION

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The study of geographical variation requires large samples of individuals from populations of diverse geographical localities. For the study of butterflies, the old methods of pinning and spreading specimens

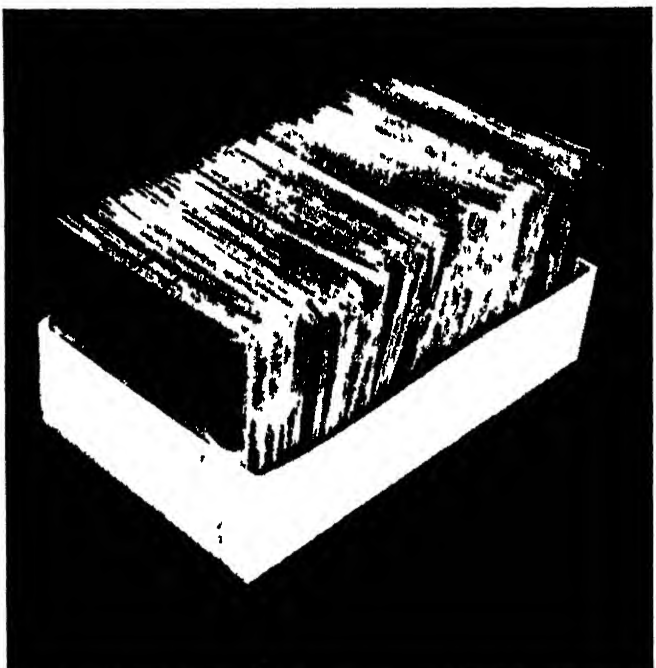

FIG. 1. A tray of specimens.

made a study of this sort almost prohibitive because of the high cost involved in the pinning, spreading and housing the material. All that is really required for the preservation of butterflies is that the specimens be dried and then protected from damage which may be inflicted by careless handling or by destructive insects.

For this purpose, a glassine paper bag has been found very convenient for the preservation, protection and filing purposes. By the use of the inexpensive glassine bag, many thousands of butterflies can be maintained for study in a space not greater than that occupied by only a few "legitimately" mounted specimens.

Glassine bags have been used for some years by collectors for the storage of unmounted material such as duplicates for which room could not be found in the cabinet. Other collectors have discouraged their use because by rough handling antennae, legs, etc., might become broken. I have found, however, that with reasonable care equivalent to that given to triangularly papered specimens or to mounted specimens, the butterflies remain in excellent condition. Specimens have been kept for over twelve years and are still in excellent condition.

The glassine bag is superior to ordinary soft paper because the contact between the paper and the butterfly wing is such that the scales on

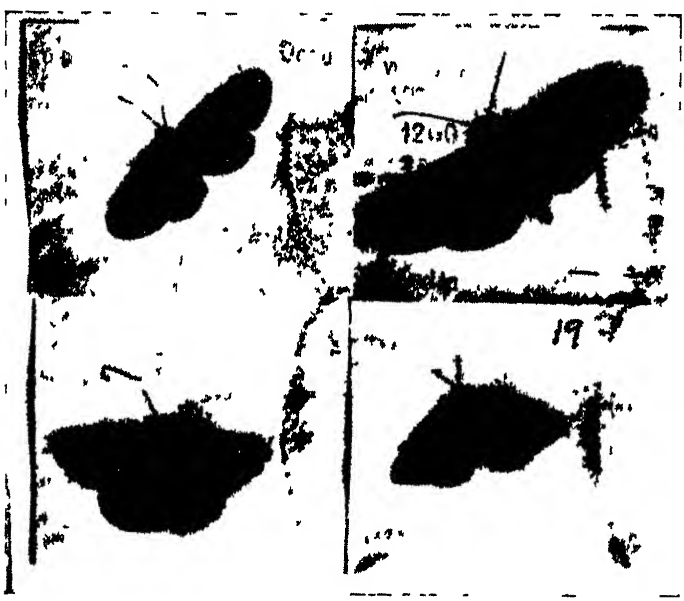

FIG. 2. Butterflies in glassine bags.

the wing may adhere to the soft paper. Because of the smooth surface of the glassine bag, the scales are not removed and it is possible to open the wings in a spread condition instead of allowing them to remain closed across the thorax. With the opened specimens protected on both sides by the semi-transparent paper, the butterflies can be observed without direct handling. Should closer scrutiny be required, the specimens can be removed from the bag easily with a pair of wide-tipped forceps.

Cellophane is superior to glassine paper for its smoothness and transparent nature but it does not permit of the drying of the specimen. For this reason, cellophane bags are not recommended. In the glassine bags, the specimens dry naturally.

It is desirable to fold over and crease the top of the glassine bag. This operation aids in retaining the specimen within and any museum

pest without. Also, the flap made by thus folding over the top creates a bumper which protects the specimens against crushing when packed.

The glassine bags can be filed on edge according to locality and species in fiberboard boxes or trays of small size. Recommended sizes for small or medium sized butterflies are the following:

bag, 2½ x 3½ inches.
box, 2½ x 3½ x 6 inches.
tray, 2½ x 3½ x 1 inch.

The glassine bag is also excellent for the transport of living female butterflies when it is desired to transport any to the laboratory for egg laying. The females are merely placed in the bag preferably with the wings folded over the thorax and they are then rendered relatively immobile. If they are not overheated or severely dessicated, the females will live for several days. Most species of the temperate regions will remain alive and immobile for many days or weeks in a refrigerator. Maintaining them in a moist chamber will aid in keeping them alive.

The illustrations show the method of placing the butterflies in the glassine bags and filing them in the trays. Complete data may be written on each bag or numbers may be written on the bags temporarily for rapid marking during the course of a trip.

PLANT HORMONES (AUXINS) AS A FACTOR IN THE HATCHING OF AEDES TRIVITTATUS (COQUILLETT) EGGS[1]

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Aedes trivittatus (Coquillett) breeds in temporary pool situations. It passes the winter in the egg stage and the larvae often may be found during summer in the temporary pools formed by rains. It is observed that there is plenty of plant growth in these pools and the most common plants are Blue-grass (*Poa sylvestris* Gr.) and nodding Fescue-grass (*Festuca nutans* Willd.). As first instar larvae are usually observed in these pools immediately after a rain, it was thought that these grasses have something to do with the eggs hatching.

Connell (1941) working on the hatching response of *Aedes sollicitans* eggs demonstrated that when the eggs were flooded for one hour every 24 hours in infusions of plants (*Spartina alterniflora*, *S. patens*, and *Distichlis spicata*) characteristic of highly saline marshes, 82, 76, and 48 per cent, respectively, of the eggs hatched. Infusions of plants (*Scirpus olneyi*, *Panicum virgatum*, and *Spartina cynosuriodes*) from marshes of lower salinity stimulated the hatching of 73, 63 and 24 per cent respectively of the eggs, while with *Zizania palustris* from fresh water tide marshes and *Cyperus ferax*, which grows in wet meadows in the interior, 64 and 35 per cent respectively of the eggs hatched. In the infusions of *Juncus effusus* and *Typha angustifolia* the hatching stimulant was present only in small quantities, if at all, since only 12 and 7 per cent respectively hatched. Connell attributed the hatching of the eggs to a stimulant present in the infusions. Gjullin, Yates and Stage (1939) found that tap water infusions of dry cottonwood leaves, willow leaves, and grass gave consistently larger hatches of *Aedes vexans* (Meig.) and *Aedes lateralis* (Meig.) (:*A. aldrichii* Dyar and Knab) eggs than either tap or river water alone. They concluded that the amino acids and proteins present in the vegetation may be the stimulants which cause the eggs to hatch when flood in nature. The same authors (1939) mentioned also that a number of organic chemicals and inorganic chemical elements necessary for plant and animal growth were tested individually and in combination but they did not cause hatching, so they eliminated in their considerations, the possibility of the effect of growth substances on the hatching. It is the object of this paper to introduce the effect of organic growth substances on the hatching of *Aedes trivittatus* eggs.

METHOD OF SECURING EGGS OF AEDES TRIVITTATUS FOR EXPERIMENTS

The eggs used in this work were deposited on damp cotton in the

[1]Contribution from the Department of Zoology and Entomology.

I wish to express my gratitude to Dr. Carl Venard, Associate Professor of Zoology and Entomology, The Ohio State University, for his helpful suggestions and supervision. Appreciation is expressed to the Botany Department, The Ohio State University, for supplying the growth chemical substances. I also wish to thank Mr. Donald Hoffman, Chemistry Department, The Ohio State University, for help in the preparation of the infusion concentrates.

bottom of glass shell vials, 65 x 22 mms. by wild adult females collected from their breeding areas by means of an aspirator after each had engorged with blood from the arms of the author. Near the end of feeding, which takes an average of one minute, they were collected by means of the aspirator and put in a pint Mason jar, the mouth of which was fitted with two overlapping pieces of thin rubber each of which having a long slit in its middle, and were so imposed that the two slits lie perpendicular to each other so as to form a (+) figure. In this way when the glass tube of the aspirator was inserted through the opening between the slits and then removed, the opening closed immediately by the elasticity of the rubber. In the laboratory the blood-engorged adult mosquitoes were isolated each in a vial having a damp cotton layer in its bottom. The opening of the vial was closed by means of a piece of muslin held in place by a small rubber band. Under laboratory conditions with a temperature fluctuating between 80° and 85° F. it took an average of three days for the blood-fed females to oviposit their quota of eggs. Not a single female of *Aedes trivittatus* survived after oviposition. The eggs were kept on the damp cotton where they had been placed by the mosquito, until experimentation.

Eggs were rendered bacteriologically sterile by immersion for five minutes in a solution of five per cent formalin and one per cent sodium hydroxide, as used by Simmons (1932) for the sterilization of blowfly eggs; and the same method adopted by Gjullin, Hegarty and Bollen (1941) for the sterilization of Aedes mosquito eggs.

EFFECT OF PLANT INFUSIONS ON HATCHING OF TRIVITTATUS EGGS

Plant infusions were prepared by soaking chopped blue grass stems and leaves in distilled water in the proportion 20 mg. of grass to each ml. of water. After letting stay for 2 hours, with shaking every half hour, the infusion was filtered through fine meshed muslin. When ten ml. of the filtrate was added to ten eggs, from 50 to 70 per cent of the eggs hatched after 30 minutes. This effect might be due to the microorganisms found in the infusion. The experiment was repeated and this time a portion of the infusion filtrate was passed through a Berkfeld filter in order to eliminate the microorganisms; another portion was autoclaved at 120° C. under 15 pounds pressure in order to see if such a treatment would affect the infusion's viability for hatching and still another portion was left without other treatment. The results are shown in Table I.[2]

[2]The percentage of eggs hatching given in the tables represent the averages of a certain number of experiments using a certain number of eggs per tube of medium in each experiment. The media were applied to the eggs in the proportion of 1 ml. of medium per egg.

Table No.	No. of Experiments Performed	No. of Eggs Used Per Tube of Medium in Each Experiment	Average Number of Eggs Used Per Tube
I.............	4	10	10
II.............	4	7	7
III.............	2	8 and 10	9
IV.............	3	5, 6 and 10	7
V.............	2	8 and 10	9

As both the micro-organism-free and the non-treated infusion in Table I gave hatchings; and although the latter gave quicker and higher per cent of hatching than the former infusion, there seemed obviously, other than the microorganismal factor inside the plant infusion which caused the hatching of *Aedes trivittatus* eggs. Also this factor is probably heat labile as it lost its hatching activity when subjected to a temperature of 120° C. under 15 pounds pressure.

TABLE I

PER CENT OF *Aedes trivittatus* EGGS HATCHING WHEN FLOODED WITH DIFFERENT TREATMENTS OF BLUE GRASS INFUSION

CONDITION OF THE INFUSION	PER CENT HATCHED AFTER					
	1 hr.	1 hr.	4 hrs.	24 hrs.	48 hrs.	72 hrs.
Non-treated Infusion	42.5	52.5	67.5	78	82.5	82.5
Micro-organism free Infusion	0	0	10	35	40	45
Autoclaved Infusion	0	0	0	0	0	0
Distilled H_2O	0	0	0	0	0	0

The experiments were repeated using concentrate of the infusion. This concentrate was prepared as follows: two grams of dried blue grass and 100 mls. of distilled water were mixed for five minutes on a Waring Blender after adding one-half gram of Celite (an inert white powder to promote filtration). The whole slurry was then filtered with suction.

TABLE II

PERCENTAGE OF *Aedes trivittatus* EGGS, HATCHING WHEN FLOODED WITH DIFFERENT TREATMENTS OF BLUE GRASS INFUSION CONCENTRATE IN DISTILLED WATER

CONDITION OF THE CONC. PLUS WATER	PER CENT HATCHED AFTER					
	½ hr.	1 hr.	4 hrs.	24 hrs.	48 hrs.	72 hrs.
Conc. plus water	18.0	28.5	46.5	64.5	68 0	75 0
Micro-organism-free conc. plus water	0	0	14	64	64	71 5
Autoclaved conc. plus water	0	0	0	0	0	0
Distilled Water	0	0	0	0	0	0

The filtrate was then concentrated under reduced pressure to about one ml. Now in order to get more or less the same infusion concentration as that of the last experiments, the concentrate was added to distilled water in the proportion of one-tenth ml. to ten mls., respectively. Then a portion of this solution was filtered through a Berkfeld filter, another portion was autoclaved and a third portion was tested without other treatment. The result of these experiments is shown in Table II.

These results show that concentration of the blue grass infusion did not destroy the active agent present inside it and responsible for the egg hatching, in fact, it looks like it has increased its activity as can be seen

from the higher per cent of hatch when the microorganisms were eliminated.

These experiments gave the author the idea of testing the effect of known organic plant growth substances, on the hatching of eggs.

EFFECT OF PLANT GROWTH HORMONES ON THE HATCHING OF AEDES TRIVITTATUS EGGS

From the many chemical substances known to promote growth in plants, three compounds were selected and experimented with; these are *α-naphthalene-acetic* acid, *indole acetic acid* and *δ-3-indole butyric* acid. The principal plant responses induced by these growth substances are: local initiation of roots on stems and leaves; local acceleration or retardation of growth, causing swelling and bending of stems; epinasty, hyponasty or twisting of leaves according to the place the compounds were applied and possibly local anaesthesia. According to Zimmerman and Wilcoxon (1935) α-naphthalene-acetic acid and indole butyric acid are the most effective root-forming substances yet discovered; they are not as effective as indole acetic acid for epinastic response of leaves.

TABLE III

PERCENTAGE OF *Aedes trivittatus* EGGS HATCHING WHEN FLOODED WITH DIFFERENT CONCENTRATIONS OF α-NAPHTHALENE ACETIC ACID IN DISTILLED WATER

CONC. OF α-NAPHTHALENE ACETIC ACID USED	PER CENT HATCHED AFTER					
	½ hr.	1 hr.	4 hrs.	24 hrs.	48 hrs.	72 hrs.
Zero–9 ppm	0	0	0	0	0	0
10 ppm	1	11	72	83	83	83
11–13 ppm	0	0	0	0	0	0
14 ppm	0	0	0	0	6	6
15–19 ppm	0	0	0	0	0	0
20 ppm	0	22	39	50	62	62
21–50 ppm	0	0	0	0	0	0

When 50 ppm solution of each of these three growth substances was prepared in distilled water and applied to eggs, no hatching took place with any of them. Dilutions starting from one ppm up were made from each of these concentrations (used as a mother liquor) and tried on *Aedes trivittatus* eggs, hatchings took place in a definite concentration range in each growth substance as can be seen in Tables III, IV and V.

It is apparent from Tables III to V that the three growth substances bring about the hatching of *Aedes trivittatus* eggs, within a certain concentration range in each.

It seems very likely that the inability of Gjullin, Yates and Stage (1939), to get hatching of *Aedes vexans* (Meig.) and *Aedes laterlais* (Meig.) eggs, from the organic chemicals necessary for plant and animal growth is that the concentrations they used must have not been in the concentration range of hatchability of these substances.

By comparing the minimum threshold values and concentration

range of these three compounds to cause bending of the stems of sweet pea and tomato, respectively, as given by Zimmerman and Wilcoxon (1935); with their threshold values and range causing hatching of

TABLE IV

PERCENTAGE OF *Aedes trivittatus* EGGS HATCHING WHEN FLOODED WITH DIFFERENT CONCENTRATIONS OF INDOLE-ACETIC ACID IN DISTILLED WATER

CONC. OF INDOLE ACETIC ACID USED	PER CENT HATCHED AFTER					
	½ hr.	1 hr.	4 hrs.	24 hrs.	48 hrs.	72 hrs.
Zero–3 ppm	0	0	0	0	0	0
4 ppm	0	0	0	5	5	5
5 ppm	0	0	0	67	81	95
6 ppm	0	0	0	0	0	0
7 ppm	0	0	0	5	10	10
8 ppm	0	0	0	5	5	10
9 ppm	0	0	0	0	0	0
10 ppm	0	0	0	29	38	57
11 ppm	0	0	0	0	0	0
12 ppm	0	0	0	0	0	0
13 ppm	0	0	0	5	10	14
14–50 ppm	0	0	0	0	0	0

TABLE V

PERCENTAGE OF *Aedes trivittatus* EGGS HATCHING WHEN FLOODED WITH DIFFERENT CONCENTRATIONS OF γ-3-INDOLE BUTYRIC ACID IN DISTILLED WATER

CONC. OF γ-3-INDOLE BUTYRIC ACID USED	PER CENT HATCHED AFTER					
	½ hr.	1 hr.	4 hrs.	24 hrs.	48 hrs.	72 hrs.
Zero ppm	0	0	0	0	0	0
1 ppm	0	0	0	0	0	0
2 ppm	0	0	0	6	6	6
3 ppm	0	0	6	39	67	72
4 ppm	6	6	6	22	39	39
5 ppm	0	0	0	44	83	83
6 ppm	0	0	0	0	0	0
7 ppm	0	0	0	11	17	22
8 ppm	0	0	0	6	6	6
9 ppm	0	0	0	0	17	28
10 ppm	6	6	6	17	44	56
11–13 ppm	0	0	0	0	0	0
14 ppm	0	0	0	6	6	11
15 ppm	6	6	6	11	17	17
16–50 ppm	0	0	0	0	0	0

Aedes trivittatus eggs as found by the author, we can see obviously that it takes infinitesimal amounts of these chemical substances to cause hatching of the eggs as compared with the tremendous amounts needed to cause response in the plants.

In working with these three growth substances it was noticed that the hatching activity was lost when their aqueous solutions stand for a week. So it is recommended that fresh solutions of these growth substances be prepared before investigating their effects.

It is worth noting that 2, 4-dichlorophenoxy acetic acid (2, 4-D) which was introduced by Zimmerman and Hitchcock (1942) together with other halogen substituted phenoxy compounds, as a plant growth substance, was tested in various concentrations ranging from one to 100 ppm. for its effect on the hatching of *Aedes trivittatus* eggs, but no hatching took place at any concentration in that range.

Further studies regarding the possibility of using these growth substances in the control of this mosquito are planned.

TABLE VI

MINIMUM THRESHOLD VALUES AND EFFECTIVE CONCENTRATION RANGE OF THE GROWTH SUBSTANCES FOR TOMATO, SWEET PEA, AND *Aedes trivittatus* EGGS, EXPRESSED IN PPM.

CHEMICAL SUBSTANCE	MIN. THRESHOLD VALUE CAUSING		CONC. RANGE CAUSING	
	Bending of sweet pea stem	Hatching of *A. trivittatus* eggs	Negative bending of tomato stem	Hatching of *Aedes trivittatus* eggs
α-naphthalene acetic acid..............	500 ppm	10 ppm	100–20,000 ppm	10–20 ppm
γ-3-indole butyric acid	250 ppm	2 ppm	100–20,000 ppm	2–15 ppm
indole acetic acid....	5 ppm	4 ppm	3–20,000 ppm	4–13 ppm

SUMMARY

Aedes trivittatus (Coquillett), which breeds in temporary pools, passes the winter in the egg stage. Blue grass infusions were found to affect hatching of the eggs, even after elimination of the microorganisms from the infusion by filtering through a Berkfeld filter. The water solutions of three plant growth substances viz.: *α-naphthaleneacetic* acid, *γ-3-indole butyric* acid and *indole acetic* acid, brought about egg hatching at a definite concentration range in each; these ranges are 10 to 20 ppm., 2 to 15 ppm. and 4 to 13 ppm., respectively. The ranges of these three growth substances are very low as compared to their ranges which cause bending of tomato stems as given by Zimmerman and Wilcoxon (1935).

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SEXUAL BEHAVIOR IN THE HUMAN MALE, by Alfred C. Kinsey, Wardell B. Pomeroy and Clyde E. Martin. xv+804 pages. W. B. Saunders Company, Philadelphia, 1918. Price $0.00.

When a book has climbed rapidly to a high place in the list of best sellers and has been reviewed extensively in the magazines and newspapers it seems almost superfluous to bring it to the attention of readers of the Annals at the necessarily late date permitted by our quarterly publication. The fact that Doctor Kinsey is an entomologist, however, makes his attainment in a different field of investigation particularly interesting to his fellow entomologists.

Since so much has been said of the book in print it is most significant to consider the nature of this reception. It has suffered some criticism for the limited number of cases considered, since it is based on studies of 5300 white males, and has also been subject to some doubt of the validity of the method of examination. On these counts the authors' comment that the number of cases so far recorded is approximately forty times as large as the amount of material on which the best previous studies were based seems to dispose effectively of the first and the incredible frankness of the disclosures seems adequate evidence of the effectiveness of the methods employed. The authors do not claim that their results are ideal nor perfect. Even though the reader may agree with them in feeling that more can be learned of the subject, if he is not hypercritical he must realize that the book is an extremely valuable addition to our knowledge of the subject.

The book is arranged in three parts: History and Method, Factors Affecting Sexual Outlet, and Sources of Sexual Outlet. It includes a detailed consideration of the incidence of all types of sex behavior, both normal and abnormal, and of their correlation with various aspects of human life such as economic and occupational status and marriage. Discussion is comparatively brief but the tabulation and graphic presentation of data are extensive. Many of the disclosures are surprising, notably the class distribution of masturbation and the differences in sexual relations in marriage in different classes of our population. The impression created by the book in the mind of the reviewer is that the authors have presented one of the first, if not the first, adequately frank and dispassionate analyses of their subject, and that the book should be a boon to parents who have young boys to raise as well as to biologists who are scientifically interested in sex relations.

It is a fairly safe assumption that the tremendous demand for the book is largely a result of curiosity about anything connected with sex. The reader who buys it to satisfy mere curiosity will probably be disappointed for he will find in it nothing that is pornographic and little that can have similar effects. It is simply a scientific presentation of materials which, from their very nature, must attract a considerable amount of undesirable attention.

In brief we may conclude that the comments of reviewers are the inevitable result of diverse points of view and of the apparent desire of many critics to find whatever weakness they can in anything that they consider. Certainly the book is a remarkable assemblage of data on a difficult subject which has been obscured too long by popular attitudes, and an able analysis and presentation of the authors' findings. The completion of their studies result in far better understanding of the problems of sex than has yet been available.—A. W. L.

LIBERATION OF ORIENTAL SCOLIOID WASPS IN THE UNITED STATES FROM 1920 TO 1946

(Hymenoptera: Scoliidae, Tiphiidae)

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During the period 1920–1933 numerous specimens of a dozen odd species of scolioid wasps were imported from the Orient and liberated in the northeastern United States for control of the introduced *Popillia japonica* Newm. [Japanese beetle], *Anomala orientalis* Waterh. [oriental beetle], *Autoserica castanea* (Arrow) [Asiatic garden beetle] and *Serica peregrina* Chapin. Subsequent to 1933 liberations were made of *Tiphia castaneaevora* Parker, *T. popilliavora* Rohwer, *T. sternata* Parker and *T. vernalis* Rohwer only.

Admirable summaries of the biological investigations on these wasps in their native countries were published by Clausen, King and Teranishi,[1] Clausen, Jaynes and Gardner,[2] and Gardner and Parker,[3] and summaries of the number of specimens shipped to the United States during the periods 1920–1928 and 1920–1933, respectively, are included in the last two papers. However, relatively few published records are available on the liberation in the United States and on the successful or unsuccessful establishment of any of the species except *T. popilliavora* and *T. vernalis*.

Recently in connection with my work on the scolioid section of a proposed cooperative Synoptic Catalog of the North American Hymenoptera, I had occasion to visit the Fruit Insect Investigations Laboratory of the Bureau of Entomology and Plant Quarantine at Moorestown, New Jersey. This visit was necessitated by the almost entire lack of published data on liberation and subsequent recovery of the parasites. Detailed card files are maintained at Moorestown showing the date, exact locality and number of specimens for each colony of parasites released in the field, and also recovery data on the various species for which subsequent scouting was done. I am indebted to C. H. Hadley, J. L. King and L. B. Parker for making these records available and for many other courtesies extended during my brief visit in Moorestown.

Inasmuch as only an extremely limited space will be available for distributional data in the proposed catalog, I will present here more detailed data on the various liberations. These data are summarized by counties under the various States in alphabetical order. The date in parentheses refers to the earliest year in which a liberation was made in that particular county—additional colonies of the successfully established species were liberated in many of the counties in subsequent years. Some brief remarks on recovery data are made following the distributional data of each species. As a result of the recovery data

[1] 1927. U. S. D. A. Bull., 1429.
[2] 1933. U. S. D. A. Tech Bull., 366.
[3] 1940. U. S. D. A. Tech. Bull., 738.

presented herein, the following species are to be regarded as established members of the North American fauna:

Tiphia asericae Allen & Jaynes
Tiphia popilliavora Rohwer
? *Tiphia sternata* Parker
Tiphia vernalis Rohwer

Family Scoliidae

Campsomeris annulata (Fabricius)

NEW JERSEY—Burlington (1925).

Over 4000 adult females and males were released in the summer and fall of 1925 and 1926 from material shipped from China and Japan. This species is normally parasitic on larger species of Scarabaeidae, particularly *Anomala* and *Phyllophaga*, but development on *Popillia japonica* was obtained in the laboratory. Apparently this species did not become established in this country, as no recoveries have been made.

Campsomeris marginella modesta (Smith)

NEW JERSEY—Burlington (1920).

More than 11,000 adult females and males were released on the grounds of the Riverton Country Club in the summers of 1920, 1922 and 1923 from material shipped from Hawaii. This species is a native of the Philippine Islands and was introduced into Hawaii as *Scolia manilae* Ashmead (= *marginella modesta*) a number of years ago for control of *Anomala orientalis*. Efforts to establish it in the United States for control of *Popillia japonica* were unsuccessful.

Family Tiphiidae

Tiphia asericae Allen & Jaynes

NEW JERSEY—Bergen (1931).
NEW YORK—Nassau (1928), Queens (1932).
PENNSYLVANIA—Montgomery (1931), Philadelphia (1930).

This species, a native of Japan, Korea and China, was liberated for the control of *Serica* and *Autoserica* in Nassau and Queens Counties, N. Y., and for the control of *Autoserica* in Bergen County, N. J., and Montgomery and Philadelphia Counties, Pa. Some of the individuals released in Nassau County, N. Y., and Montgomery and Philadelphia Counties, Pa., established themselves, for recoveries were made one or more years after the original liberations. Recoveries were made from one Philadelphia County colony as late as 1938. I have examined 4 ♀♀ and 11 ♂♂ recovered in the field from colonies one or more years old. These specimens were identified as *asericae* by L. B. Parker, and I am able to confirm his determination.

Tiphia bicarinata Cameron

CONNECTICUT—New Haven (1926).
NEW JERSEY—Burlington (1926).

Three females were released in Connecticut in the fall of 1926 and almost 1000 females and males in New Jersey in the fall of 1926 and

summer of 1927 from cocoons shipped from Korea for control of *Anomala orientalis*. Apparently the species failed to become established, for recoveries have never been made.

Tiphia biseculata Allen & Jaynes

New Jersey—Camden (1926).
New York—Nassau (1929).

Over 1500 males and females of this Japanese species were released in New Jersey and New York in 1926 and 1929, respectively, for control of *Popillia japonica*. In the summer of 1933 about 4500 females and males were liberated in Nassau County, N. Y., for control of *Anomala orientalis*. Apparently none of these colonies became established.

Tiphia castaneaevora Parker

New Jersey—Burlington (1935).
Pennsylvania—Montgomery (1934), Philadelphia (1934).

About 400 females and males were liberated in New Jersey in 1935 and about 4700 females and males in Pennsylvania in 1934 and 1935 from Japanese material for control of *Autoserica castanea*. Apparently none of these colonies became established, for recoveries have never been made.

Tiphia frater Parker

New Jersey—Burlington (1926).

About 10 females from cocoons from China were liberated, but apparently the species did not become established.

Tiphia matura Allen & Jaynes

New Jersey—Burlington (1929).

About 300 females and 20 males from cocoons from India were liberated in October for control of *Popillia japonica*. Apparently this species did not become established.

Tiphia notopolita var. **alleni** Roberts

New York—Nassau (1933).

About 200 females and 60 males were liberated in 1933 from cocoons reared in Japan for control of *Anomala orientalis*. Apparently this species did not become established.

Tiphia popilliavora Rohwer

To date taxonomic studies have failed to reveal any morphological differences between the Japanese, Korean, and Chinese strains of this species. However, they do differ consistently in emergence dates both in their native countries and in the United States, the Korean strain being two weeks later than the Japanese and three weeks earlier than the Chinese. Releasement records for the Japanese and Korean strains (the only two in use in the United States) are maintained separately at the Japanese Beetle Laboratory, and I have summarized these data separately inasmuch as future taxonomic work may reveal reliable structural characters for their separation. The species is an effective parasite of *Popillia japonica*.

Tiphia popilliavora Rohwer (Japanese strain)

CONNECTICUT—Fairfield (1937), Hartford (1937), New Haven (1928), New London (1938), Windham (1938).
DELAWARE—New Castle (1934).
MARYLAND—Anne Arundel (1939), Caroline (1939), Cecil (1934), Dorchester (1938), Harford (1938), Kent (1938), Prince Georges (1939), Queen Annes (1939), Somerset (1938), Washington (1938), Wicomico (1939), Worcester (1938).
NEW JERSEY—Burlington (1921), Camden (1927), Gloucester (1927), Hunterdon (1935), Mercer (1928), Middlesex (1934), Monmouth (1935), Salem (1931), Somerset (1934).
NEW YORK—Nassau (1927), New York City (1939), Queens (1928), Westchester (1938).
OHIO—Cuyahoga (1943), Guernsey (1943).
PENNSYLVANIA—Bucks (1927), Chester (1930), Cumberland (1934), Dauphin (1929), Delaware (1928), Montgomery (1928), Philadelphia (1927).
VIRGINIA—Chesterfield (1939), Henrico (1944), Norfolk (1939), Northampton (1939), Westmoreland (1944).

Scouting work in 1945 established that colonies over two years old were flourishing in all states but Maryland (no scouting was done in Virginia or Ohio).

Tiphia popilliavora Rohwer (Korean strain)

CONNECTICUT—New Haven (1945).
DELAWARE—New Castle (1937).
MARYLAND—Cecil (1937), Harford (1942).
NEW JERSEY—Camden (1927), Hunterdon (1935), Mercer (1935), Middlesex (1936), Somerset (1936).
NORTH CAROLINA—Buncombe (1943) Henderson (1943).
OHIO—Mahoning (1942).
PENNSYLVANIA—Chester (1936), Delaware (1934), Montgomery (1935), Philadelphia (1935).
VIRGINIA—Chesterfield (1945), Henrico (1945).

Scouting work in 1945 established that colonies over two years old were present in New Jersey and Pennsylvania. None could be found in Delaware or Maryland, and scouting was not done in the other States.

Tiphia pullivora Allen & Jaynes

PENNSYLVANIA—Montgomery (1928).

About 1400 females and 3705 males were liberated in the summer and fall of 1928 from cocoons from India for control of *Popillia japonica*. Apparently this species failed to become established.

Tiphia sternata Parker

NEW JERSEY—Burlington (1935), Essex (1935), Union (1935).
NEW YORK—Nassau (1933), Queens (1933).
PENNSYLVANIA—Montgomery (1933), Philadelphia (1934).

Females of this species were liberated for control of *Serica* from field collected adults from Japan. One female was collected in 1937 in Burlington Co., N. J., where a colony had been liberated the previous

year. This specimen was determined as *sternata* by L. B. Parker, and I am able to confirm his identification. Subsequent scouting was not done, and it is not known whether this colony has maintained itself.

Tiphia totopunctata Allen & Jaynes

NEW YORK—Nassau (1927).

Fifteen mated females and 16 males were liberated for control of *Anomala orientalis* from cocoons from Korea. Apparently the species did not become established.

Tiphia vernalis Rohwer

CONNECTICUT—Fairfield (1936), Hartford (1938), Middlesex (1945), New Haven (1936), New London (1937), Windham (1938).
DELAWARE—Kent (1936), New Castle (1934).
DISTRICT OF COLUMBIA—(1934).
MARYLAND—Anne Arundel (1939), Baltimore (1934), Cecil (1934), Dorchester (1936), Frederick (1936), Harford (1938), Howard (1939), Kent (1938), Prince Georges (1939), Queen Annes (1939), Somerset (1938), Talbot (1939). Washington (1936), Wicomico (1938), Worcester (1938).
MASSACHUSETTS—Hampden (1932), Middlesex (1944), Worcester (1944).
NEW HAMPSHIRE—Cheshire (1937), Merrimac (1936), Strafford (1936).
NEW JERSEY—Atlantic (1936), Bergen (1940), Burlington (1926), Camden (1927), Cape May (1936), Cumberland (1934), Essex (1940), Gloucester (1932), Hunterdon (1935), Mercer (1932), Middlesex (1933), Monmouth (1933), Morris (1939), Ocean (1933), Passaic (1941), Salem (1932), Somerset (1933), Union (1937).
NEW YORK—Albany (1944), Broome (1946), Chemung (1939), Columbia (1944), Dutchess (1941), Livingston (1944), Monroe (1939), Nassau (1927), Ontario (1944), Orange (1940), Putnam (1942), Queens (1930), Rockland (1939), Saratoga (1944), Schuyler (1945), Seneca (1946), Staten Island (1937), Suffolk (1944), Tioga (1939), Tompkins (1944), Ulster (1943), Westchester (1939).
NORTH CAROLINA—Buncombe (1943), Henderson (1943).
OHIO—Cuyahoga (1941), Guernsey (1943), Mahoning (1945).
PENNSYLVANIA—Allegheny (1945), Berks (1936), Bucks (1929), Chester (1932), Clinton (1945), Cumberland (1934), Dauphin (1934), Delaware (1931), Lancaster (1940), Lehigh (1937), Luzerne (1943), Lycoming (1944), Monroe (1937), Montgomery (1927), Montour (1945), Northampton (1943), Northumberland (1944), Philadelphia (1930), Snyder (1944), Westmoreland (1944), York (1942).
RHODE ISLAND—Bristol (1944), Newport (1944), Providence (1936), Washington (1945).
VIRGINIA—Arlington (1941), Chseterfield (1941), Fairfax (1943), Henrico (1941), Loudoun (1944), Norfolk (1943), Spottsylvania (1942), Stafford (1945).
WEST VIRGINIA—Taylor (1941).

Scouting in 1945 and again in 1946 established that colonies over two years old were present in all States scouted except Rhode Island and the District of Columbia. No scouting was done in Ohio, North Carolina, Virginia, or West Virginia in either year. This species is an important factor in the control of *Popillia japonica* in the United States.

CUBAN FLATIDAE WITH NEW SPECIES FROM ADJACENT REGIONS

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This is one in a series of papers (Metcalf and Bruner 1925a, 1925b, 1930a, 1936a, and 1944a) devoted to a survey of the homopterous fauna of Cuba. The FLATIDAE is one of the larger families of the superfamily FULGOROIDEA. In our catalogue of this family there are recorded at the present time 184 genera and 894 species from various parts of the world. The number of species in the Palearctic fauna is small, and the Nearctic fauna has a limited number of species. But the Caribbean, Neotropical, Oriental, Ethiopian, Malaysian, Austro-Malayan and Australian faunas have a large number of species. The family is well represented in Cuba. The present paper records 16 genera and 42 species of which 9 genera and 32 species are believed to be new.

CHARACTERS OF THE FAMILY

This family may be characterized as follows: Body strongly compressed or depressed; tegmina and wings ample, held vertically or horizontally in repose. This character alone is sufficient to distinguish this family from the other families of superfamily FULGOROIDEA with the exception of the family ACANALONIIDAE in which the body is greatly compressed and the tegmina are ample and held vertically when at rest. And in the family ACHILIDAE all the species have the body greatly depressed. In the ACANALONIIDAE, however, there is no crossveined costal area and the hind tibiae are without lateral spines. In the ACHILIDAE there is no costal area, and the second tarsus of hind legs is not small. Other characters of the family FLATIDAE may be stated briefly as follows: Head small; compound eyes large, ventral sinus inconspicuous or wanting; two ocelli in the lateral compartments, ventrad to the compound eyes; antennae inconspicuous, first segment usually small, collarlike, second segment longer, somewhat capitate, flagellum long; crown short, usually no distinct cephalic process sometimes triangularly or conically produced; pronotum usually short and broad, separated into a distinct central area and lateral areas by a pair of very distinct intermediate carinae; mesonotum large, frequently tricarinate; tegmina large, vertical or horizontal; a distinct crossveined costal area; venation distinct but reticulate and irregular; legs simple, first and second pairs usually short; hind tibiae elongate with one or more spines usually on the apical third; second hind tarsus short with a pair of spines on the apical margin. The male genitalia furnish the most reliable specific characters; pygofer usually short and simple; genital plates large, united basad and with a large tooth on the dorsal margin; aedeagus usually tubular, elongate, straight or curved with an apical pair of spines, a preapical pair of spines and a subapical pair of spines; anal segment usually elongate, broad, and flat with apical portion often strongly deflexed, hoodlike, covering the rest of the genitalia; female

genitalia simple and incomplete. The lateral valvifers are large with rows of teeth along the inner ventral margin; ovipositor short, usually curved.

We wish to acknowledge the assistance of many collectors, whose names will be indicated in the text by their initials only, as follows:

J. A.—J. Acuna	M. J.—Miguel Jaume
B. T. B.—B. T. Barreto	A. R. O.—A. R. Otero
C. H. B.—C. H. Ballou	L. C. S.—L. C. Scaramuzza
L. B. León Bouclé	G. C. R.—G. C. Rowe
S. C. B.—S. C. Bruner	E. A. S.—E. A. Schwarz
P. G. C.—P. G. Cardin	F. S.—F. Silvestri
A. C.—Arturo Comas	C. F. S.—C. F. Stahl
E. D.—E. Ducasse	F. Z.—F. de Zayas

The types of all new forms are in the collection of the senior author.

KEY TO THE GENERA OF CUBAN FLATIDAE

A. Tegmia vertical or steeply tectiform..................Subfamily **Flatinae**

B. Tegmina broadly rounded apically, costal and apical margins merging...Tribe **Phantiini** (*Byllisana* Metc. and Brun.)

BB. Tegmina with costal and apical margins distinct.

C. Tegmina broadly triangular.............................. 1

1. Sutural angle triangularly produced or distinctly rectangular...............................Tribe **Flatissini.** 2

1. Sutural angle rounded.................Tribe **Nephesini.** 4

2. Crown triangular, distinctly produced..**Carthaeomorpha** Mel. (Central and South American species.)

2. Crown obtuse, not produced, shorter on median line than on lateral margins.................................. 3

3. Frons longer than broad with a pair of impressed points on dorsal margin; pronotum with a distinct median carina; sutural angle of tegmina distinctly produced. **Dakshiana** Metc. and Brun.

3. Frons broader than long, no impressed points; pronotum ecarinate with a pair of impressed points; sutural angle rectangular, not produced.....**Monoflatina** Metc. and Brun. (Jamaican species.)

4. Sutural angle distinctly produced; apical margin sinuate. **Leocerus** Metc. and Brun.

4. Sutural angle not produced; apical margin truncate...... 5

5. A single subapical line on corium...................... 6

5. Two distinct subapical lines on corium.......**Ormenis** Stål

6. Costal margin distinctly longer than sutural margin; apical angle produced caudad beyond sutural angle. **Ormenaria** Metc. and Brun.

6. Costal and sutural margins about equal; apical angle not produced caudad.................................... 7

7. Frons broader than long or as broad as long............. 8

7. Frons distinctly longer than broad..................... 9

8. Pronotum almost completely covering vertex. **Ormenana** Metc. and Brun.

8. Vertex not covered by pronotum...........**Monoflata** Mel.

9. Only a few of the longitudinal veins forked beyond subapical line.............................**Ormenoides** Mel.

9. Most of the longitudinal veins forked beyond the subapical line...........................**Melormenis** Metc.

CC. Tegmina narrow; costal margin sinuate........Tribe **Selizini.** 1

1. Tegmina broad across humeri, narrowed caudad; apical margin sinuate; apical angle produced caudad..**Cyarda** Walk.

1. Tegmina about same width throughout; apical margin truncate; apical angle not produced. **Planodascalia** Metc. and Brun.

AA. Tegmina horizontal or nearly so....................Subfamily **Flatoidinae**
B. Subcostal vein and costal margin of tegmina undulate; tegmina not narrowed caudad.
C. Crown distinctly broader than long, composed in great part of the reflexed portion of frons......**Flatarissa** Metc. and Brun.
CC. Crown distinctly longer than broad, composed entirely of vertex..............................**Pseudoflatoides** Metc.
BB. Costal vein and costal margin not undulate; tegmina usually narrowed caudad.
C. Dorsal margin of frons triangularly incised. **Flatidula** Metc. and Brun.
CC. Dorsal margin of frons straight or nearly so................. 1
1. Crown about as long as broad, anterior margin obtuse. **Flatarina** Metc. and Brun.
1. Crown much broader than long, anterior margin triangularly produced..........................**Flatoidinus** Mel.

Genus **Byllisana** nov.

Orthotype **Byllisana brunnea** n. sp.

Orthotype *Byllisana brunnea* n. sp.

This is the second American genus of the Tribe *Phantiini*. In this tribe the costal margin curves imperceptibly into the apical margin and there is no distinct apical angle.

Head including compound eyes as broad as pronotum; vertex short and completely covered by pronotum except lateral angles; frons about as broad as long; tegmina broad and short; apical angle broadly rounded; costal margin merging imperceptibly into apical margin; costal area about as wide as costal cell; costal vein merging into the subapical line which is parallel to apical margin; cubitus one furcate basad to radius; the subapical line parallel to apical margin; second branch of radius and media furcate at about same level; most of longitudinal veins simple beyond subapical line; hind tibiae with two spines on apical third.

Byllisana brunnea n. sp.

(Pl. VI, figs. 3, 6; Pl. XIV, figs. 3, 6)

This is a small species almost uniformly cinnamon brown in color with the carinae of the head, thorax and legs bright ochraceous buff.

Vertex short, almost completely covered by the extended pronotum; lateral compartments triangular; dorsal area of frons impressed; frons slightly broader than long; dorsal margin longer than clypeal margin; lateral margins strongly arched, widest at about the level of antennae, strongly reflexed; median carina inconspicuous; clypeus about as long as frons, the frontal margin deeply impressed; pronotum slightly broader than compound eyes; anterior margin distinctly projected; posterior margin deeply incised; mesonotum broad and flat, tricarinate; tegmina with costal margin broadly arched into apical margin; venation distinct and variable with few crossveins, except in costal area and beyond subapical line.

Male genitalia with pygofer short and broad; genital plates broad, elongate, dorsal apical tooth somewhat elongate, recurved, acute; aedeagus with a pair of subapical, elongate spines placed near ventral margin; apical spines, which are about half as long as subapical spines

somewhat undulate; anal segment elongate with a very large ventral apical plate.

General color cinnamon or cinnamon brown with lateral margins of frons, carina on thorax, and costal margin of tegmina usually light ochraceous buff. Recently emerged adults are covered with a white pruinescence which soon disappears more or less by abrasion.

Length to apex of tegmina: 3.75–4.50 mm.

Holotype ♂: Santiago de las Vegas, Habana Prov.; S. C. B. *Allotype* ♀: Santiago de las Vegas, Habana Prov.; S. C. B. *Paratypes:* 2 ♂♂, Habana, Habana Prov.; 22 Apr., 1916; S. C. B. 3 ♀♀, Habana, Habana Prov.; 22 Apr., 1916; S C B. 1 ♂, Marianao, Habana Prov.; 7 Dec, 1921; S C. B. 1 ♀, Marianao, Habana Prov ; 30 Jan., 1927; S C. B. 1 ♂, Mangas, Pinar del Rio Prov.; 6 June, 1937; S C. B. and L. C. S 1 ♂, Alquizar, Habana Prov.; 9 June, 1934; L. C. S. 1 ♂, Central Moron, Camaguey Prov.; 24 March, 1927; S. C. B. 1 ♂, Sierra Rangel Mts, Pinar del Rio Prov.; 29 Aug., 1927; 1500 ft ; J. A. and S. C. B. 1 ♀, Vinales, Pinar del Rio Prov ; 15 Apr., 1930; S. C B 1 ♀, Vinales, Pinar del Rio Prov.; 15 Apr., 1930; S. C. B. 1 ♂, Vinales, Pinar del Rio Prov.; 7 Apr., 1922; S. C. B. and J. A. 7 ♀♀, Santiago de las Vegas, Habana Prov.; 5 Feb., 1927; S. C. B. 1 ♀, Central Cuba Matanzas Prov.; 25 March, 1927; S. C. B. 1 ♀, Vibora, Habana Prov. 10 Jan., 1929; S. C. B. 1 ♀, Benavides, Matanzas Prov.; 11 June, 1932 S. C. B, A. R. O. and L. C. S. 1 ♀, Cape Baragua, Camaguey Prov. 11 July, 1939; L. C. S. 1 ♀, Jaronu, Camaguey Prov ; 1 June, 1934; L. C. S. 1 ♂, Vento, Habana Prov.; 28 Nov., 1920; J A.

It has been found breeding on *Centrosoma* sp. and *Miebomia supina* growing on dry savannas.

Genus **Carthaeomorpha** Melichar

(Melichar 1901a: 198)

Logotype *Carthaemorpha rufipes* Melichar, Oshanin 1912a 125.

Crown broad and short; anterior and posterior margins nearly parallel, broadly curved with a distinct carina separating the crown from frons; frons slightly longer than broad, flat; lateral margins strongly elevated, broadly curved; median carina distinct dorsad; tegmina large, apex truncate; sutural angle strongly produced; venation reticulate, longitudinal veins distinct; costal cell broader than costal area, media branched before the first cubital sector; hind tibiae with two spines on apical third

Carthaeomorpha balloui n. sp.

(Pl. I, fig. 6; Pl. VI, fig. 7; Pl. XIV, figs. 9, 10)

This is a rather large species of a general light olive green color; the veins of the tegmina and the pustules on the clavus are darker olive

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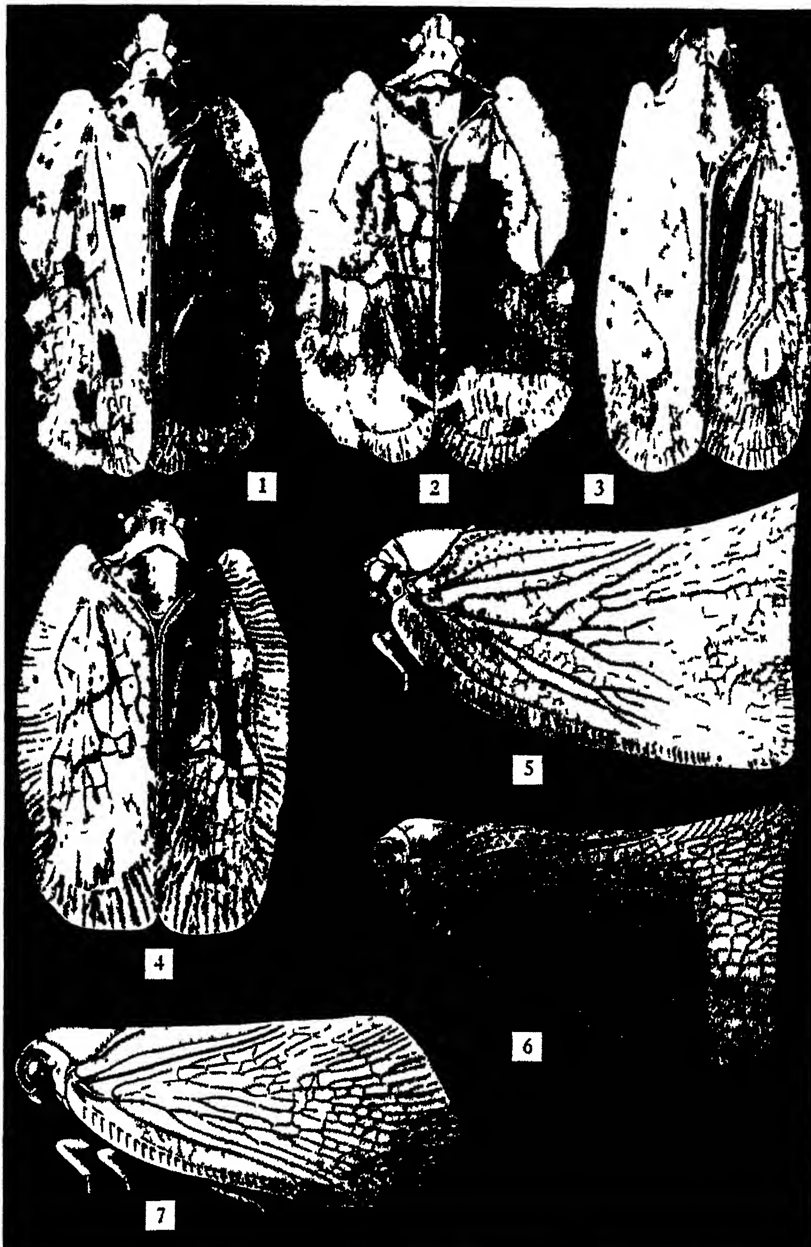
EXPLANATION OF PLATE I

Fig. 1. *Pseudoflatoides fasciculosus* var. *maculosus* Metc. and Brun. Fig. 2. *Pseudoflatoides lichenoides* Metc. and Brun. Fig. 3. *Flatidula pallescens* Metc. and Brun. Fig. 4. *Flatarissa variegata* Metc. and Brun. Fig. 5. *Dakshiana katharina* Metc. and Brun. Fig. 6. *Carthaeomorpha balloui* Metc. and Brun. Fig. 7. *Ormenaria rufifascia* Walk.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green; tipe of the tibiae and the entire tarsi ochraceous orange; lateral area of the mesonotum and the posterior half ochraceous orange.

Vertex broad and flat, about two and one-half times as broad as median length separated from frons by a distinct transverse carina; median carina fairly distinct; frons about half again as long as its greatest width; lateral margins strongly elevated, nearly straight and somewhat diverging to the level of the antennae, then converging to the smaller clypeus; median and intermediate carinae about one-half as long as frons, fairly distinct; pronotum short, broad, the anterior margin carinate, broadly curved, posterior margin deeply incised; median carina distinct; intermediate carinae indistinct; mesonotum large, tricarinate; tegmina large, sutural angle strongly produced, uniformly reticulate; costal cell broader than costal margin with numerous crossveins; hind tibiae with two stout spines on apical third.

Male genitalia with genital plates when viewed ventrally elongate, about six times as long as greatest width; apical margin obtuse, when viewed laterally broadly triangular, with a distinct apical tooth; aedeagus large, with a short bifurcate apical tooth and an elongate subapical tooth; anal segment elongate.

Length to apex of tegmina: 13.00–13.30 mm.

Holotype ♂: San Pedro de Montes de Oca, Costa Rica, on *Amygdalus persica*; 20 Feb., 1933; C. H. B. *Allotype* ♀: San Pedro de Montes de Oca, Costa Rica, on *Amygdalus persica*; 1 Sept., 1933; C. H. B. *Paratypes:* 1 ♂, San Pedro de Montes de Oca, Costa Rica, on *Amygdalus persica*; 21 March, 1933; C. H. B.

Genus **Dakshiana** nov.

Orthotype *Dakshiana katharina* n. sp.

This genus is characterized by a short crown, large tegmina, with sutural angle strongly produced. It is close to *Carthaeomorpha* Mel. but differs in essential characters as indicated below.

Crown very short, all except the lateral anterior angles, nearly covered by pronotum; anterior margin sinuate, not parallel to posterior margin; face broader than long; lateral margins strongly elevated; median carina fairly distinct dorsad, fading out ventrad; pronotum with dorsal area about twice as broad as long; median carina percurrent, lateral margins strongly elevated; anterior margin truncate; posterior margin shallowly excavate; mesonotum large, tricarinate; tegmina large, the costal area narrow with numerous crossveins; corium finely reticulate over the whole surface; apical margin slightly concave, apical angle rounded, sutural angle strongly produced.

EXPLANATION OF PLATE II

Fig. 1. *Flatoidinus acutus* Uhl. Fig. 2. *Flatidula luella* Metc. and Brun. Fig. 3. *Flatoidinus olivaceus* Metc. and Brun. Fig. 4. *Planodascalia viridicosta* Metc. and Brun. Fig. 5. *Planodascalia viridicosta* Metc. and Brun. Fig. 6. *Melormenis asymmetrica* Metc. and Brun.

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Dakshiana katharina n. sp.

(Pl. I, fig. 5; Pl. VI, figs. 2, 5; Pl. XIV, figs. 5, 7)

The fresher specimens of this species appear to be nearly uniform pale dull greenish with the tegmina lightly powered with a whitish pruinescence. The older specimens fade to light ochraceous buff with the veins, carinae, and margins of legs bright red.

Crown very short; lateral margins strongly elevated, separated from frons by a very distinct transverse carina; frons with the margins nearly parallel to below antennae, then curving inward to the smaller clypeus; lateral margins strongly elevated; median carina fairly distinct dorsad, legs short; pronotum with anterior margin projecting cephalad to level of anterior margin of compound eyes; posterior margin broadly sinuate; median carina strongly elevated; lateral margins strongly elevated, curving outward and then ventrad parallel to margin of compound eyes; mesonotum broad, tricarinate; tegmina closely reticulate over entire surface; costal area with numerous closely arranged crossveins, narrower than costal cell; sutural angles strongly acutely triangularly produced; apical angle short, broadly rounded.

Male genitalia plates when viewed ventrad broad, nearly quadrangular; pygofer small; anal segment large with a large triangular ventral plate; genital plates when viewed laterad with a strong apical dorsal tooth; aedeagus rather large, with an elongate recurved apical spine which has a midventral short spine; there is also an elongate twisted lateral spine on aedeagus.

Length to apex of tegmina: ♂, 9.25 mm., ♀, 12.25 mm.

Holotype ♂: Calabazar, Habana Prov., on *Nectandra coriacea* Gris; 5 Aug., 1928; S. C. B. *Allotype* ♀: Loma del Gato, Oriente Prov.; 1–2 Oct., 1935; 2600–3325 ft.; J. A and S. C. B. *Paratypes*: 1 ♂, San Blas, Santa Clara Prov; Oct., 1931; G. C. R. 1 ♂, Calabazar, Habana Prov., on *Nectandra coriacea* Gris.; 5 Aug., 1928; S. C. B. 1 ♂, Sierra Maestra, Oriente Prov.; 10–20 July, 1922; 3100–4000 ft; C. H. B. and S. C. B. 1 ♂, Las Animas, Sierra Rangel Mts., Pinar del Rio Prov.; May, 1933; 1500 ft 2 ♀♀, Santiago de las Vegas, Habana Prov.; 24 Oct., 1915; S. C. B 1 ♀, Sierra Rangel Mts, Pinar del Rio Prov.; 29 Aug., 1927; 1500 ft; J A. and S. C. B 1 ♀, Calabazar, Habana Prov., on *Nectandra coriacea* Gris; 5 Aug., 1928; S. C. B. 1 ♀, Nagua, Oriente Prov; 7 July, 1922; S. C. B. and C. H. B.

Genus **Monoflata** Melichar

(Melichar 1923a: 76)

Orthotype *Poekilloptera brasiliensis* Spinola.

This genus was established to include *Poekilloptera brasiliensis* Spinola from Brazil and *Ormenis pallescens* from Mexico. This genus

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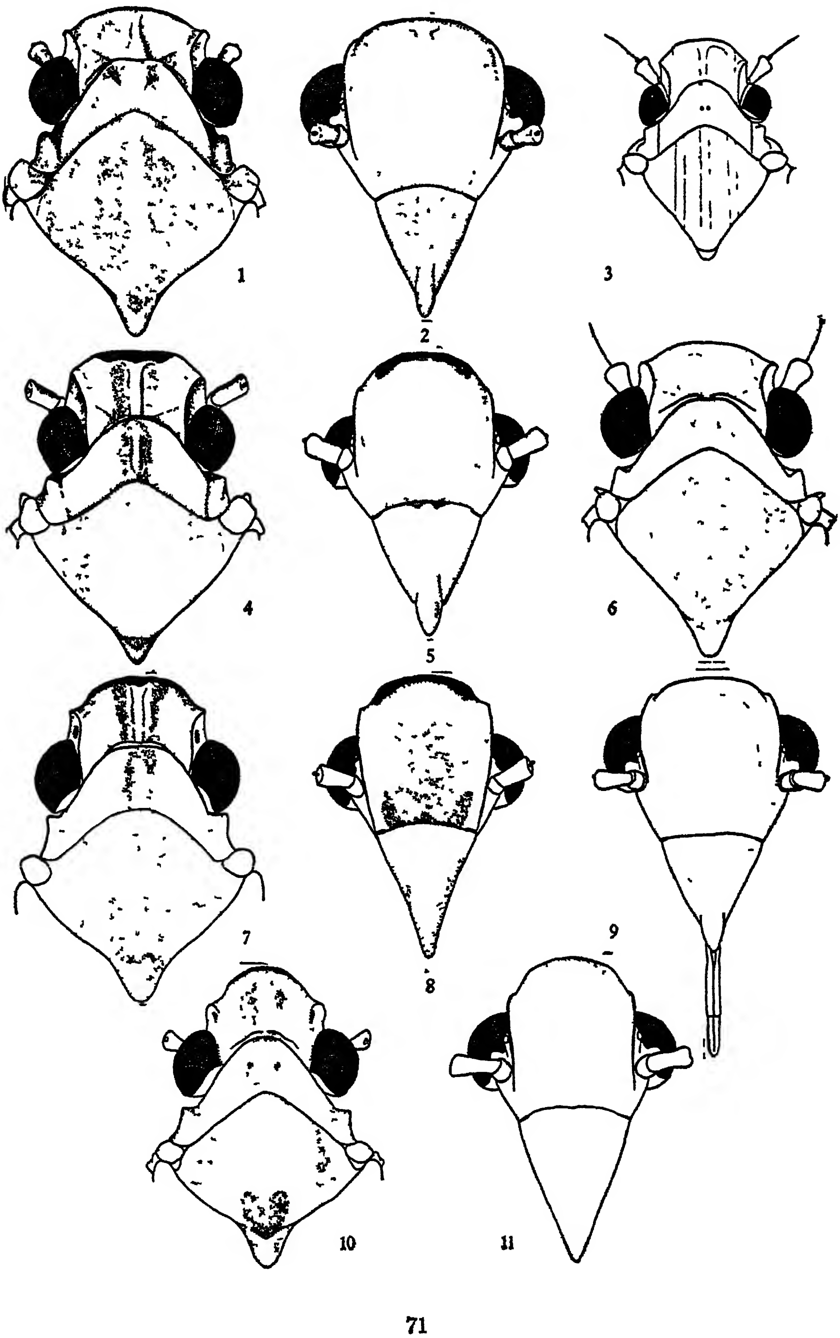
EXPLANATION OF PLATE III

Frontal Views of Head, Dorsal Views of Head and Thorax

Fig. 1. *Cyarda acuminipennis* Spin. Fig. 2. *Cyarda acuminipennis* Spin. Fig. 3. *Cyarda acutissima* Metc and Brun Fig. 4. *Cyarda cubensis* Metc. and Brun Fig 5. *Cyarda cubensis* Metc and Brun. Fig. 6. *Cyarda walkeri* Metc. Fig. 7. *Cyarda fuscifrons* Metc and Brun Fig 8 *Cyarda fuscifrons* Metc. and Brun Fig 9 *Cyarda walkeri* Metc. Fig 10. *Cyarda melichari* Van D. Fig. 11. *Cyarda melichari* Van D.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is a very distinct genus of the *Ormenis* group with a fairly broad face with the lateral margins broadly arcuate, strongly elevated and united to the median carina by a distinct transverse carina at the apex of the head. The tegmina are distinctly widened apically, venation very distinct, a single subapical line forming numerous apical cells about as long as the costal cells.

Monoflata perpusilla Fowler

(Pl. V, figs. 7, 10)

Flata perpusilla Fowler 1900f: 53; Pl. 7, fig. 16.

We have a single female specimen of this species from St. Lorenzo, Honduras; 7 Apr, 1923; C. H. B. The head and thorax is chiefly brownish fuscous with crown, pronotum and mesonotum dorsally bright green fading to greenish yellow; lateral margins of pronotum and mesonotum brownish fuscous and apical angle of mesonotum also brownish fuscous; midline of crown, pronotum and mesonotum broadly vittate with bright scarlet red; tegmina bright green, faintly dotted with paler green, with the costal, apical, and sutural margins from apex of clavus to sutural angle, the humeral margin, and apex of clavus marked with fuscous.

Genus **Monoflatina** nov.

Orthotype *Monoflatina viridipennis* n. sp.

This seems to be a very distinct genus of the Tribe Flatissini. The sutural angle is distinctly rectangular but not produced; subapical line wanting; pronotum covers most of crown, broadly produced on anterior margin, bipunctate, ecarinate; mesonotum very large, indistinctly tricarinate; frons broad and short with lateral margins slightly elevated; median intermediate carinae distinct on dorsal half; tegmina large; costal area about three times as broad as costal cell; venation distinct but irregular; radius branched beyond branching of media; media with usually four branches distinct; first cubital sector branched before branching of media; hind tibiae with two spines on apical third.

Monoflatina viridipennis n. sp.

(Pl. V, figs. 8, 11)

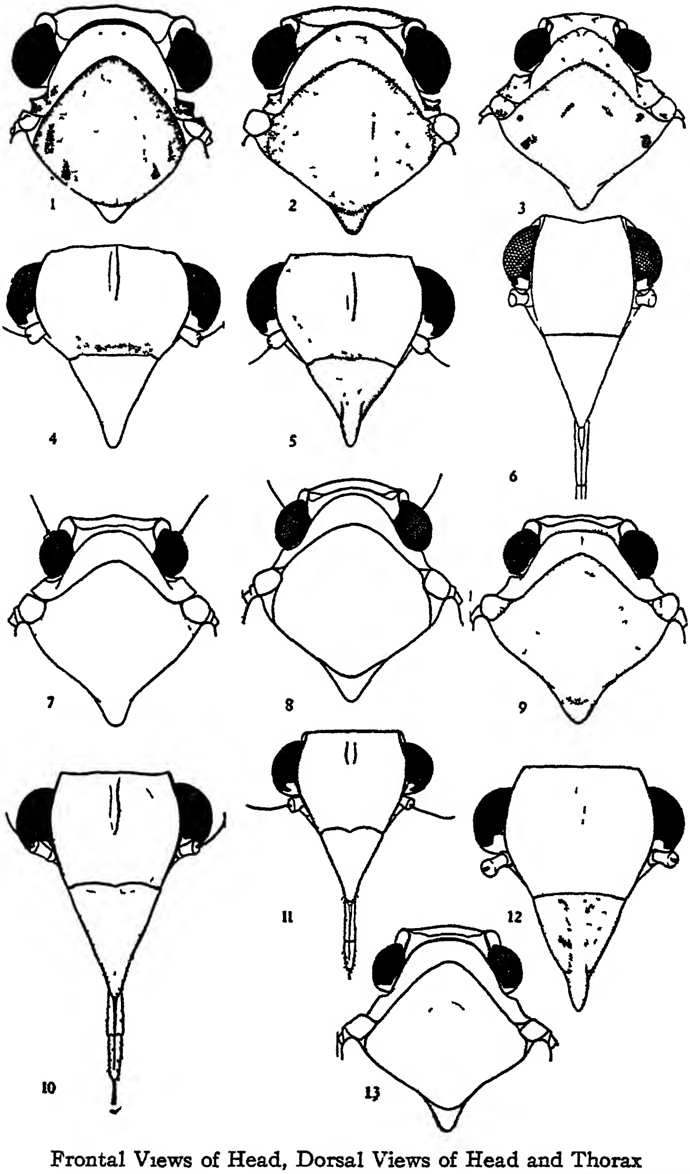
This is a pale greenish species indistinctly marked with tawny.

Crown very short, almost completely covered by extending pronotum, distinctly separated from frons by transverse carina; frons about as broad as long, tricarinate; lateral margins broadly curved; pronotum short, broadly projecting in front of compound eyes; mesonotum large, indistinctly tricarinate; tegmina large.

General color greenish with venation distinctly brighter green; head, pronotum, mesonotum, venter, and legs fading to tawny; compound eyes brown; tegmina with an indistinct border of brownish fuscous extending from humeral angles around apical margin to apex of clavus.

Length to apex of tegmina: 7.60 mm.

Holotype ♀ : Jamaica, 5 Oct., 1923; C. H. B.



Frontal Views of Head, Dorsal Views of Head and Thorax

Fig. 1. *Planodascalia viridicosta* Metc. and Brun. Fig. 2. *Planodascalia fusca* Metc. and Brun. Fig. 3. *Leocerus fuscus* Metc. and Brun. Fig. 4. *Planodascalia viridicosta* Metc. and Brun. Fig. 5. *Planodascalia fusca* Metc. and Brun. Fig. 6. *Leocerus fuscus* Metc. and Brun. Fig. 7. *Melormenis persea* Metc. and Brun. Fig. 8. *Melormenis asymmetrica* Metc. and Brun. Fig. 9. *Melormenis inconspicua* Metc. and Brun. Fig. 10. *Melormenis persea* Metc. and Brun. Fig. 11. *Melormenis asymmetrica* Metc. and Brun. Fig. 12. *Melormenis inconspicua* Metc. and Brun. Fig. 13. *Melormensis pruinosa cubana* Metc. and Brun.

Genus **Deocerus** nom. nov.

For *Neocerus* Melichar [1902] nec *Neocerus* Wasmann [1893].

Orthotype *Neocerus corniculatus* Melichar.

The genus *Neocerus* was proposed by Melichar in 1902 for a single species *Neocerus corniculatus* from Venezuela. This name, however, is preoccupied by the name *Neocerus* Wasmann. We are therefore proposing the above new name for this genus. Briefly the genus may be characterized as follows Frons somewhat elongate with a distinct median carina; dorsal margin of the frons incised; tegmina elongate, the apical margin broadly sinuate sutural angle roundly produced, with a single distinct subapical line; hind tibiae with a single spine.

Genus **Leocerus** nov.

In the venation of the tegmina, this genus bears a superficial resemblance to *Juba* Jacobi. The head structures are entirely different and resemble in general *Deocerus* Metcalf and Bruner.

Head narrower than pronotum, the crown quadrilateral, about three times as broad as the median length, frons elongate, the lateral margins broadly curved; dorsal margin triangularly incised; dorsal and clypeal margins nearly equal; central area longitudinally depressed; pronotum projecting anteriorly beyond anterior margin of compound eyes, posterior margin deeply incised; mesonotum large, dorsal area broadly flattened; tegmina elongate, costal margin slightly sinuate, apical margin broadly sinuate; sutural angle produced and broadly rounded; costal area broad, broader than costal cell; numerous crossveins; two subapical lines about equidistant from each other and apical margin; whole area of corium reticulate, hind tibiae with two spines on apical third.

Leocerus fuscus n. sp.

(Pl. IV, figs. 3, 6; Pl. VII, figs. 2, 4; Pl. XI, figs. 4, 7)

Crown very short, almost bisected by the projecting pronotum, anterior margin of which is much more sharply rounded than the carinate anterior margin between crown and frons; frons slightly longer than its greatest width, a weak median carina dorsad, dorsal and clypeal margins nearly equal, lateral margins strongly elevated, broadly curved; clypeus about as long as median length of frons; pronotum much wider than its median length, the posterior margin more sharply incised than curve of the anterior margin; mesonotum rather long, dorsal surface nearly flat, smooth and shiny; tegmina with numerous crossveins in apical area; the two subapical lines fairly distinct and continuous

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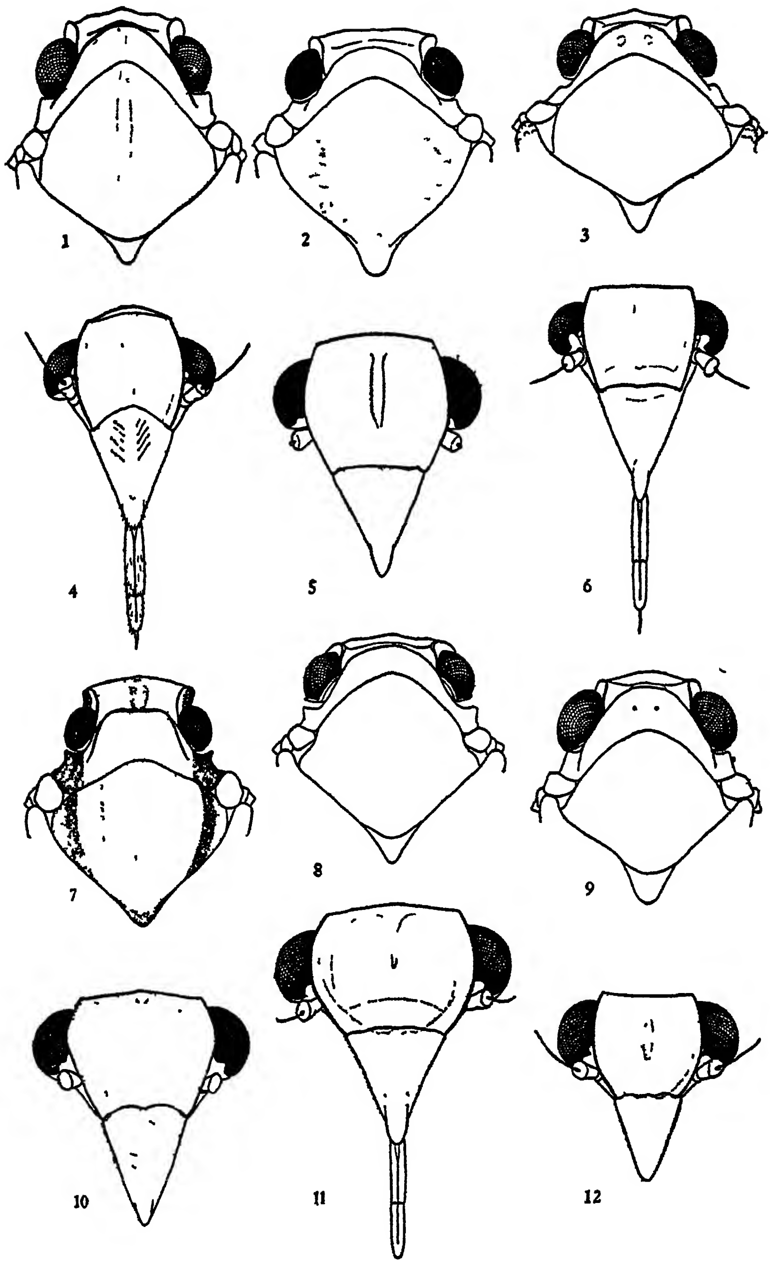
EXPLANATION OF PLATE V

Frontal Views of Head. Dorsal Views of Head and Thorax

Fig 1. *Ormenaria rufifascia* Walk. Fig 2. *Melormenis variegata* Metc and Brun Fig. 3 *Ormenoides subflava* Metc. and Brun. Fig. 4 *Ormenaria rufifascia* Walk. Fig. 5. *Melormenis variegata* Metc and Brun. Fig. 6. *Ormenoides subflava* Metc and Brun Fig 7. *Monoflata perpusilla* Fowl Fig 8. *Monoflatina viridipennis* Metc and Brun Fig 9 *Ormenaria linki* Heid and Osb. Fig 10 *Monoflata perpusilla* Fowl Fig 11. *Monoflatina viridipennis* Metc and Brun. Fig 12. *Ormenaria linki* Heid and Osb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Male genitalia with pygofer short and broad; genital plates about twice as long as broad with a distinct apical tooth on dorsal margin; aedeagus elongate, slender, with a single subapical, somewhat recurved spine; the tenth segment rather heavy basad, with apex beyond anal style narrow, strongly decurved.

General color light ochraceous buff, with the following markings fuscous or tawny: Anterior carina of crown and dorsal margin of frons, two indistinct lines either side of median area of pronotum, and numerous small punctate marks on pronotum, lateral areas of mesonotum, basal angle of clavus, costal margins, and most of the apical third of tegmina; there is also a series of narrow elongate dashes just inside the strongly carinate margins of frons; paratype is darker than holotype with general color of body ochraceous orange, and the darker markings blackish instead of tawny or fuscous, and more extensive.

Length to apex of tegmina: 7.00 mm.

Holotype ♂: Baracoa, Oriente Prov ; 21–30 Apr., 1929; S. C. B. and L. B. *Paratype:* Baracoa, Oriente Prov.; 15 July, 1935; F. Z *Allotype* ♀: Los Llanos, Maisi, Oriente Prov.; 5 Feb., 1929; J. A.

Genus **Ormenis** Stål

(*Ormenis* Stål 1862e: 68)

Logotype *Ormenis perfecta* Walker.

This genus may be recognized by the following combinations of characters: Crown very short, partially concealed by projecting pronotum; frons broad, median carina indistinct; pronotum short, broad, usually bipunctate; mesonotum large; tegmina large with two subapical lines on corium; most of longitudinal veins forked beyond last subapical line; costal area wider than costal cell; apical and sutural angles equally rounded; hind tibiae with two stout spines on apical fourth.

Ormenis cubensis n. sp.

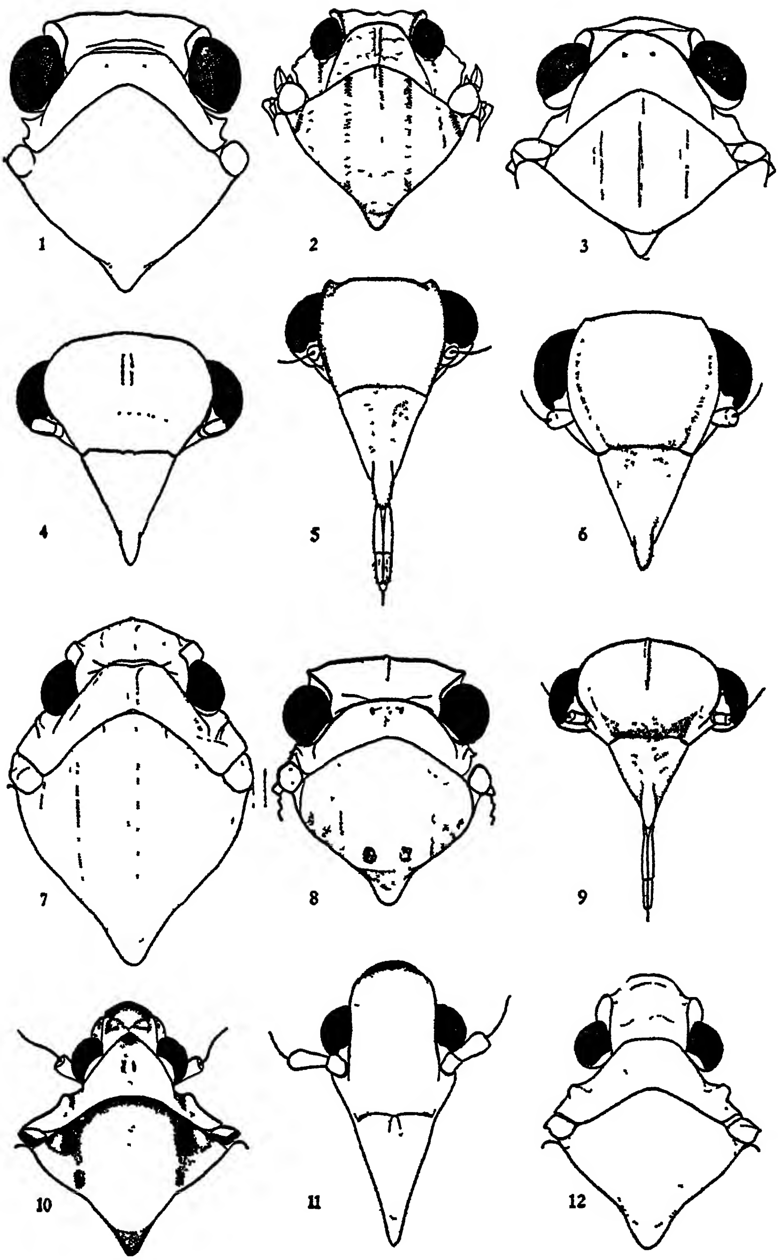
(Pl. VI, figs. 1, 4; Pl. XIII, figs. 10, 11)

This is a small species of *Ormenis*, nearly uniformly tawny olive in color, perhaps greenish in living specimens, with face and legs yellowish buff and a small black dot at apex of clavus and two small black dots on posterior lateral margins of mesonotum, the anterior pair larger; frons broader than long, the lateral margins not strongly elevated; median carina indistinct; tegmina long and narrow, costal margin three or four times as broad as costal cell; both subapical lines very distinct and about equidistant from each other and apical margin; most of longitudinal veins branched beyond last subapical line.

EXPLANATION OF PLATE VI

Frontal Views of Head, Dorsal Views of Head and Thorax

Fig. 1. *Ormenis cubensis* Metc. and Brun. Fig. 2. *Dakshiana katharina* Metc. and Brun. Fig. 3. *Byllisana brunneuas* Metc. and Brun. Fig. 4. *Ormenis cubensis* Metc. and Brun. Fig. 5. *Dakshiana katharina* Metc. and Brun. Fig. 6. *Byllisana brunneuas* Metc. and Brun. Fig. 7. *Carthaeomorpha balloui* Metc. and Brun. Fig. 8. *Planodascalia obscura* Metc. and Brun. Fig. 9. *Planodascalia obscura* Metc. and Brun. Fig. 10. *Flatarissa humeralis* Metc. and Brun Fig. 11. *Flatarissa humeralis* Metc. and Brun Fig. 12. *Flatarina aguiari* Metc. and Brun.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Male genitalia with pygofer somewhat elongate, the dorsal apical angle somewhat produced; genital plates elongate, nearly quadrate, about twice as long as broad, the dorsal apical angle produced in the short rounded tooth; aedeagus broad, somewhat curved, with short apical spines; preapical spines shorter than subapical spines; subapical spines elongate, curved; anal segment elongate, almost as long as pygofer and genital plates combined; apical area elongate, strongly deflexed.

Length to apex of tegmina: 6.90 mm.

Holotype ♂: San Blas, Trinidad Mts., Las Villas Prov.; 5 May, 1932; S. C. B. and A. R. O. *Allotype* ♀: San Blas, Trinidad Mts., Las Villas Prov.; 5 May, 1932; S. C. B. and A. R. O.

Genus **Ormenaria** nov.

Orthotype *Poekilloptera rufifascia* Walker.

This genus falls in that group of genera that include *Ormenoides* Mel. and *Melormenis* Metc., which have put a single subapical line on the tegmina and frons distinctly longer than broad. This genus is most closely related in these characters to *Melormenis* Metc., which has most of the longitudinal veins forked beyond the subapical line. It differs, however, in important respects, from this genus.

Head including compound eyes but little narrower than pronotum; crown very short; frons longer than broad; lateral margins nearly parallel to below antennae and then narrowing to the narrow postclypeus, strongly elevated; median carina of frons percurrent and continued distinctly on to clypeus; pronotum projecting cephalad to anterior margin of crown with a well-developed median carina; mesonotum tricarinate; tegmina elongate, narrow; venation very distinct; subapical line strongly developed, apical angle distinctly produced beyond sutural angle; costal area narrow, about as wide as costal cell; most of longitudinal veins furcate beyond subapical line; hind tibiae with two spines.

Ormenaria rufifascia Walker

(Pl. I, fig. 7; Pl. V, figs. 1, 4; Pl. XIII, figs. 7, 8)

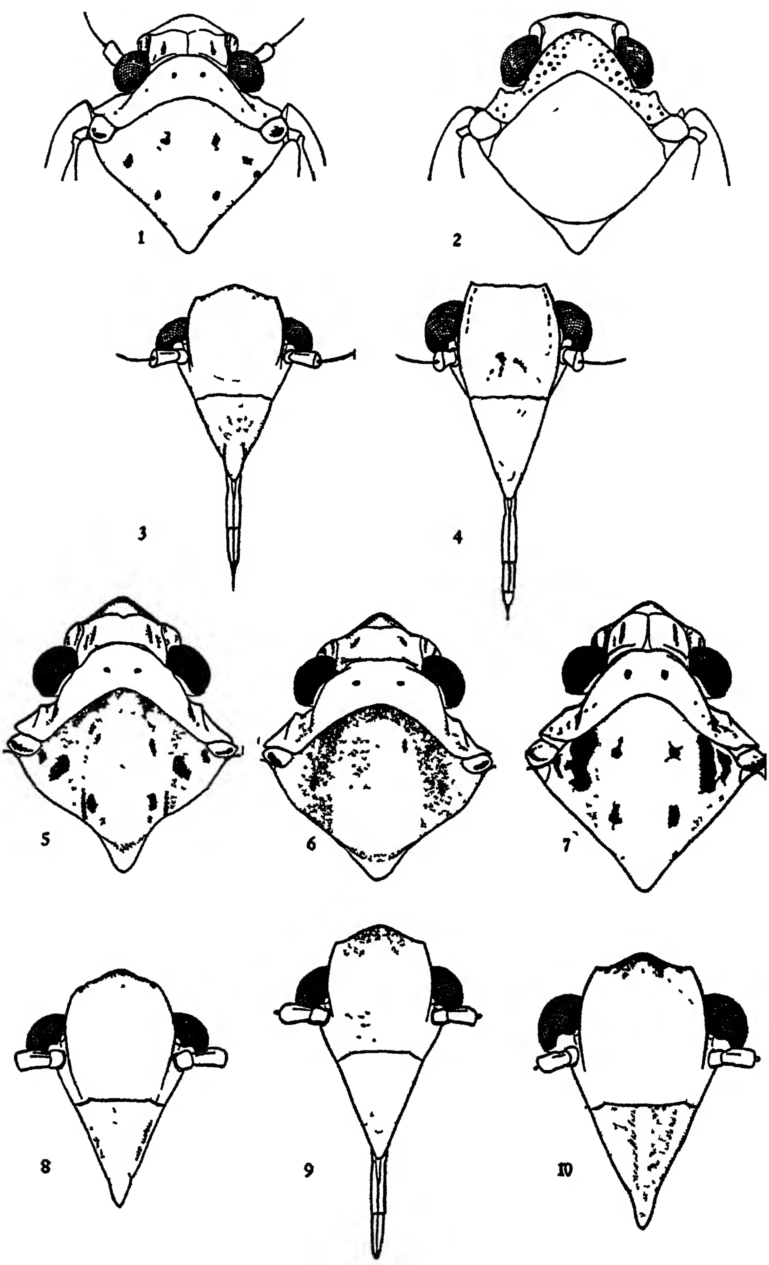
Poekilloptera rufifascia Walker 1851a: 458.
Ormenis rufifascia Melichar 1902a: 101.
Ormenis rufifascia Metcalf 1923a: 152; Pl. 38, fig. 10; Pl. 48, fig. 142.
Anormenis rufifascia Melichar 1923a: 69.

This species may be distinguished from other Cuban flatids by the following color characters: Head and thorax bright rufus marked with bright pale green; tegmina pale greenish with veins heavily marked with bright grass green; tegmina in the older specimens fade to light buff with veins ochraceous orange; the bright colors of head and thorax seem to be very well retained even in the older specimens.

EXPLANATION OF PLATE VII

Frontal Views of Head, Dorsal Views of Head and Thorax

Fig. 1. *Flatoidinus olivaceus* Metc. and Brun. Fig. 2. *Leocerus fuscus* Metc. and Brun. Fig. 3. *Flatoidinus olivaceus* Metc. and Brun. Fig. 4. *Leocerus fuscus* Metc. and Brun. Fig. 5. *Flatoidinus acutus* Uhl. Fig. 6. *Flatoidinus dotatus* Mel. Fig. 7. *Flatoidinus pallescens* Metc. and Brun. Fig. 8. *Flatoidinus acutus* Uhl. Fig. 9. *Flatoidinus dotatus* Mel. Fig. 10. *Flatoidinus pallescens* Metc. and Brun.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Crown reduced to two triangular lateral compartments beyond lateral margins of projecting pronotum; frons as long as broad; clypeus longer than frons; pronotum but little broader than head; anterior margin broadly produced to anterior margin of crown; posterior margin deeply incised; mesonotum about as broad as long, quadrangular, tricarinate; venation very distinct and fairly constant; subapical line distinct; most of the apical veins furcate beyond subapical line.

Male genitalia with genital plates short, broad, only about half as long as aedeagus or anal segment with a dorsal terminal elongate tooth, which is slightly recurved and acuminate; aedeagus long, slender with a pair of subterminal fleshy processes directed caudad and a pair of branched spines located on the apical third; the dorsal branch nearly straight; ventral branch strongly recurved and directed caudad; anal segment elongate, longer than aedeagus.

Length to apex of tegmina: 8.00–12.00 mm.

This species was described from Florida and has been recorded from Georgia. We have specimens from the Province of Pinar del Rio (W. T. Horne, C. H. B.) and the Isle of Pines (A. R. O.) taken on the Barrel Palm, *Colpothrinax wrightii*, and on Palmetto Palm, *Sabal* sp.

Genus **Ormenana** nov.

Orthotype *Ormenis linki* Heidemann and Osborn.

This genus is close to *Melormenis* Metc. Head including compound eyes nearly as wide as pronotum; crown short and broad; vertex almost completely concealed by the extended pronotum, separated from the coronal part of frons by a fine but distinct transverse carina; frons lyre-shaped, about as broad as long, sometimes slightly longer than broad, with dorsal and clypeal margins nearly equal; a distinct median carina; pronotum with anterior margin broadly projecting well in front of compound eyes; posterior margin broadly excavate; tegmina elongate, narrow, almost of equal width from humeral angles to apex; costal and sutural angles about equal; costal area narrower than costal cell with numerous crossveins; a single subapical line; most of the longitudinal veins forked beyond apical line; basal half of tegmina with few or no crossveins, apical half with a few irregular crossveins.

Ormenana linki Heidemann and Osborn

(Pl. V, figs. 9, 12; Pl. XIV, fig. 4)

Ormenis linki Heidemann and Osborn 1917a: 347.

This species was described from the Isle of Pines. We have specimens from the same locality with examples from practically every

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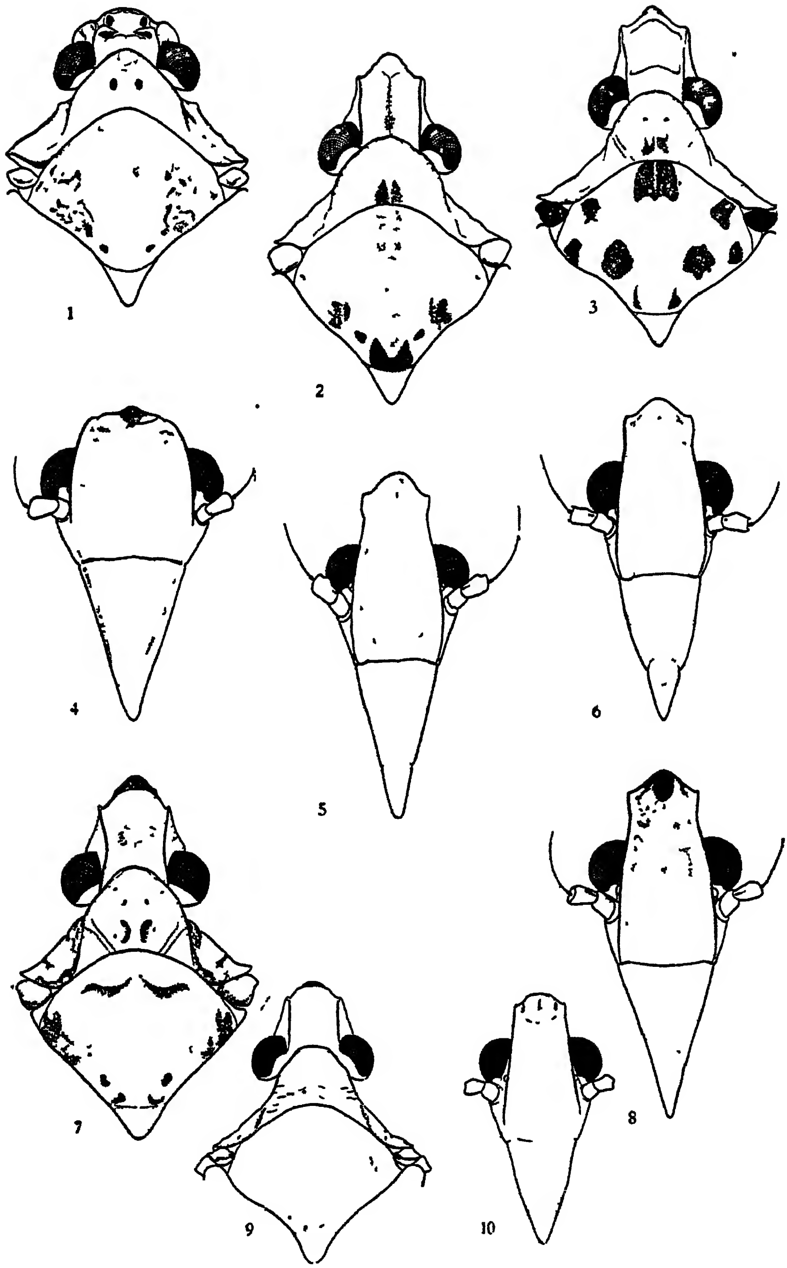
EXPLANATION OF PLATE VIII

Frontal Views of Head, Dorsal Views of Head and Thorax

Fig. 1. *Flatarissa variegata* Metc. and Brun. Fig. 2. *Pseudoflatoides fasciculosus* var. *griseus* Mel. Fig. 3. *Pseudoflatoides fasciculosus* var. *maculosus* Metc. and Brun. Fig. 4. *Flatarissa variegata* Metc. and Brun. Fig. 5. *Pseudoflatoides fasciculosus* var. *griseus* Mel. Fig. 6. *Pseudoflatoides fasciculosus* var. *maculosus* Metc. and Brun. Fig. 7. *Pseudoflatoides fasciculosus* Mel. Fig. 8. *Pseudoflatoides fasciculosus* Mel. Fig. 9. *Pseudoflatoides tortrix* var. *insularis* Mel. Fig. 10. *Pseudoflatoides tortrix* var. *insularis* Mel.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region where extensive collections have been made from Pinar del Rio Province to Oriente Province. It may be recognized by its small size, almost uniform fuscous brown color with the costal area pale ochraceous buff.

Head including compound eyes about as wide as pronotum; vertex very short, its greatest width nearly ten times the median length, lateral margins strongly elevated; frons slightly longer than greatest width, lateral margins strongly elevated; median carina faint with a pair of faint intermediate carinae; tegmina elongate, narrow, venation distinct.

Male genitalia with pygofer short and broad; genital plates short, broad, somewhat triangular, dorsal tooth on base of apical third, elongate; aedeagus with a pair of short apical spines and a pair of short subapical spines; anal segment elongate, deflexed, with a pair of lateral projections at about the middle.

Length to apex of tegmina: 4.75–5 00 mm.

Ormenana nana n. sp.

(Pl. XIII, fig. 2)

This species resembles *Ormenana linki* in general structure. It differs in averaging somewhat larger and is decidedly lighter in color than that species.

Crown very short and broad, almost completely covered by the projecting pronotum; face about as broad as long, lateral margins strongly arched; median carina very short; pronotum strongly and broadly produced on anterior margin, surpassing anterior margin of compound eyes; posterior margin broadly incised; mesonotum large; tegmina elongate, venation indistinct; subapical line not very evident.

Male genitalia with pygofer short and broad; genital plates short and broad; dorsal tooth near apex elongate, acuminate, slightly recurved; aedeagus short and stout; apical spines hooklike; preapical spines very short; subapical spines longer than apical spines, straight; tenth segment elongate, deflexed.

General color fuscous brown, the anterior margin of pronotum, lateral margins of frons, the legs and venter generally lighter; costal margin distinctly lighter.

Length to apex of tegmina: 6.10 mm.

Holotype ♂: Baragua, Camaguey Prov.; 3 Oct., 1924; C. F. S. *Allotype* ♀: Manzanillo, Oriente Prov.; 16 Oct., 1928; L. C. S. *Paratypes:* 1 ♀, Manzanillo, Oriente Prov.; 16 Oct., 1928; L. C. S.

Ormenana fusca n. sp.

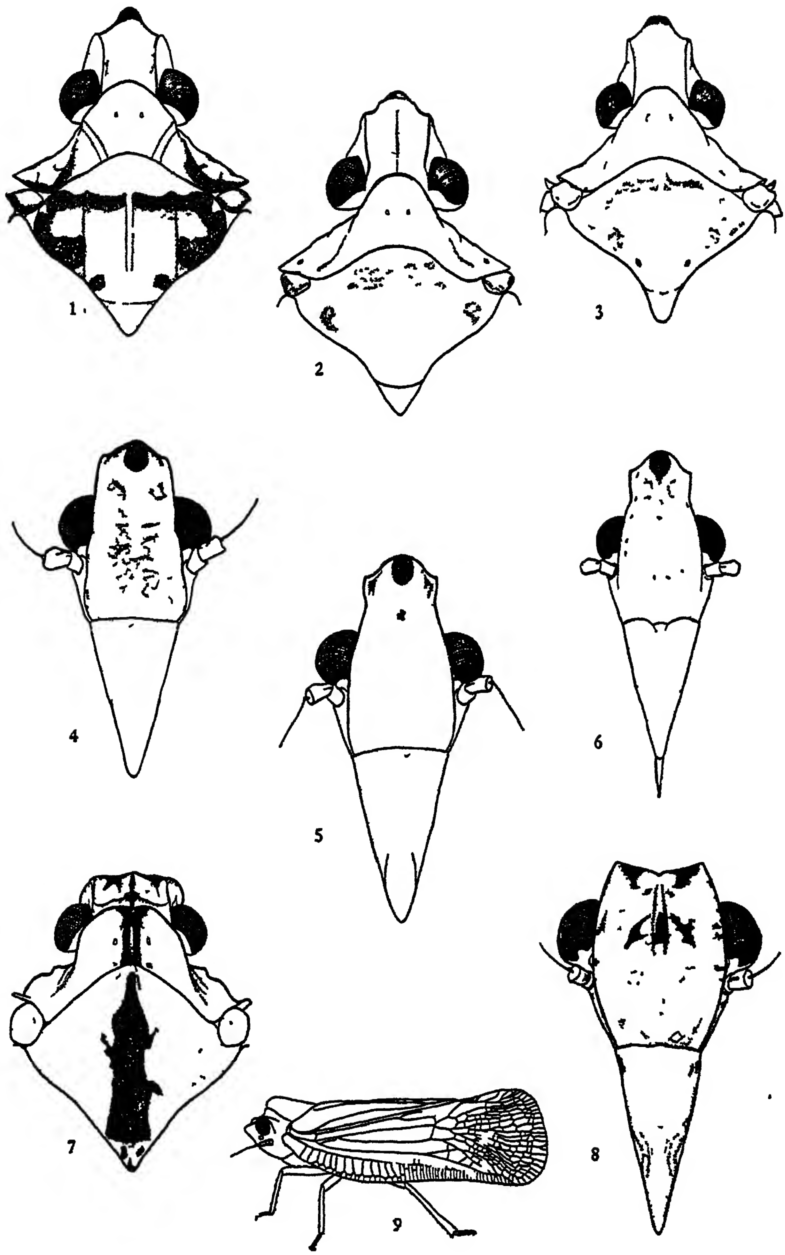
(Pl. XIII, fig. 9)

This species closely resembles *Ormenana linki* in general structure and coloration but the genitalia are distinct.

EXPLANATION OF PLATE IX

Frontal Views of Head, Dorsal Views of Head and Thorax

Fig. 1. *Pseudoflatoides lichenoides* Metc. and Brun. Fig. 2. *Pseudoflatoides fasciculosus* var. *vittatus* Metc. and Brun. Fig. 3. *Pseudoflatoides tortrix* Guér.-Mén. Fig. 4. *Pseudoflatoides lichenoides* Metc. and Brun. Fig. 5. *Pseudoflatoides fasciculosus* var. *vittatus* Metc. and Brun. Fig. 6. *Pseudoflatoides tortrix* Guér.-Mén. Fig. 7. *Flatidula luella* Metc. and Brun. Fig. 8. *Flatidula luella* Metc. and Brun. Fig. 9. *Flatidula luella* Metc. and Brun.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Vertex short and broad, lateral margins strongly and sharply elevated; frons slightly longer than broad, lateral margins strongly elevated and broadly curved with an indistinct median carina on basal third connected to a broadly elevated transverse carina; costal area narrower than costal cell; venation fairly distinct; subapical line distinct; apical and sutural angles equally rounded, apical margin obtuse; hind tibiae with two spines on apical third.

Male genitalia with pygofer short and broad; genital plates nearly twice as long as their greatest width, excluding dorsal tooth, longer than in *linki*, more slender; aedeagus with apical spines elongate with a short tooth on base; subapical spines elongate, curved, almost as long as aedeagus; anal segment elongate, slender, strongly deflexed on apical half; lateral processes broad, nearly quadrate.

In general color head and thorax dorsally russet brown; tegmina blackish fuscous with costal margin and claval suture ochraceous buff; face and legs chiefly ochraceous buff with abdomen russet brown; compound eyes tawny.

Length to apex of tegmina: 5.00–5.25 mm.

Holotype ♂: Banes, Oriente Prov.; 4–11 June, 1927; F. T. B. *Allotype* ♀: Manzanillo, Oriente Prov.; 16 Oct., 1928; L. C. S. *Paratypes:* 1 ♂, Central Palma, Oriente Prov.; 11 Sept., 1934; L. C. S. 1 ♀, Maisi, Oriente Prov.; 5 Feb., 1929; J. A. 1 ♀, Central Palma, Oriente Prov.; 11 Sept., 1934; L. C. S. 1 ♀, Camagüey, Camagüey Prov.; 8 July, 1923; J. A.

Ormenana punctata n. sp.

(Pl. XII, fig. 3)

This is a small species of *Ormenana* suggestive of *Melormenis pruinosa*, but differs in being much smaller and in having different genitalia.

Frons about as broad as long, median carina indistinct, the lateral margins strongly elevated, broadly curved; tegmina relatively broad and short; costal area broad with numerous closely spaced crossveins.

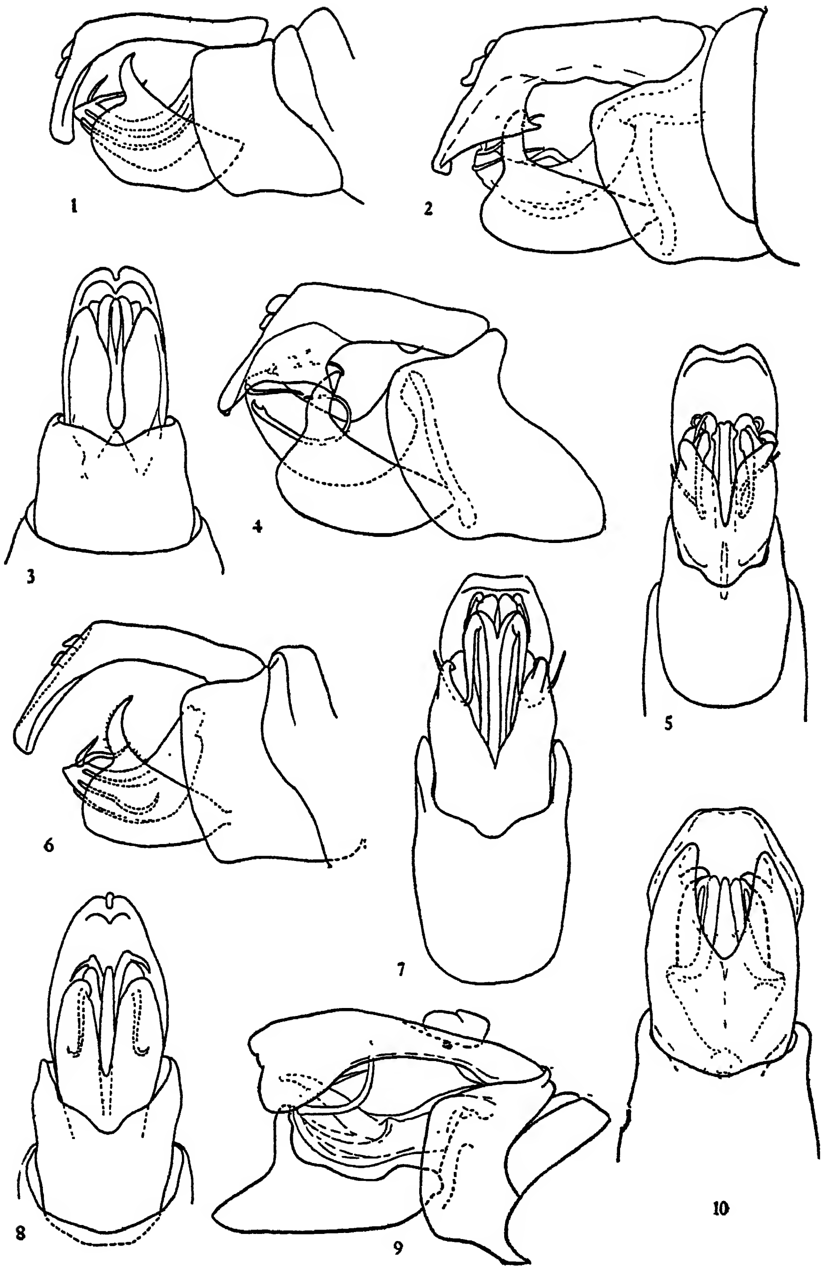
Male genitalia with pygofer short; genital plates short and broad with an elongate subapical dorsal tooth; aedeagus large with branched apical spines with anterior branch shorter; elongate subapical spines almost as long as aedeagus; anal segment nearly as long as pygofer and genital plates combined; apical portion elongate, slender when viewed laterally, curvingly deflexed.

Head, pronotum, venter, and legs chiefly light ochraceous buff; mesonotum and tegmina chiefly blackish fuscous; claval suture narrowly ochraceous buff; costal margin narrowly ochraceous buff; a small spot in front of the humeri, a larger spot behind the humeri, and an elongate stigmatal spot ochraceous buff.

EXPLANATION OF PLATE X

Lateral and Ventral Views of Male Genitalia

Fig. 1. *Cyarda acutissima* Metc. and Brun. Fig. 2. *Cyarda acuminipennis* Spin. Fig. 3. *Cyarda acutissima* Metc. and Brun. Fig. 4. *Cyarda walkeri* Metc. Fig. 5. *Cyarda acuminipennis* Spin. Fig. 6. *Cyarda cubensis* Metc. and Brun. Fig. 7. *Cyarda walkeri* Metc. Fig. 8. *Cyarda cubensis* Metc. and Brun. Fig. 9. *Flatarissa variegata* Metc. and Brun. Fig. 10. *Flatarissa variegata* Metc. and Brun.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Length to apex of tegmina: 5.50 mm.

Holotype ♂: Baracoa, Oriente Prov.; 15 April, 1916; P. G. C. *Paratypes:* 2 ♂♂, Baracoa, Oriente Prov.; 15 April, 1916; P. G. C.

Ormenoides Melichar

Ormenoides Melichar 1923a: 73.

Orthotype *Ormenoides distinctus* Mel.

This genus may be recognized by the following combinations of characters: Crown very short and broad, almost completely covered by extended pronotum, frons distinctly longer than broad; median carina usually distinct; pronotum short and broad, usually triangularly projecting between compound eyes; tegmina with single subapical line usually parallel to apical margin; costal area narrower than costal cell.

Ormenoides subflava n. sp.

(Pl. V, figs. 3, 6; Pl. XIV, fig. 1)

This is a medium-sized species of *Ormenoides* which is almost uniformly tawny orange in color. In some specimens there is a faint clouding of brown on lateral areas of mesonotum, the basal area of clavus, across basal cells and on apical area of tegmina Other specimens are nearly uniformly warm sepia. The costal margin is nearly always paler than any other area of the body.

Crown almost completely covered by pronotum, separated from frons by a very distinct transverse carina; frons somewhat longer than broad; lateral margins strongly elevated; median carina distinct; pronotum distinctly produced, the anterior margin transverse; posterior margin shallowly excavate; mesonotum without distinct carina; tegmina short and broad; costal margin nearly straight; apical margin truncate.

Male genitalia with genital plates elongate, narrow, with a well-developed recurved middorsal tooth; aedeagus elongate, slender, with short apical spines with basal tooth; subapical spines slender, elongate, about half as long as aedeagus, somewhat recurved.

Length to apex of tegmina: 7.75–8.25 mm.

Holotype ♂: Sierra Maestra, Oriente Prov.; 10–20 July, 1922; C. H. B. and S. C. B. *Allotype* ♀: Sierra Maestra, Oriente Prov.; 10–20 July, 1922; C. H. B. and S. C. B. *Paratypes:* 3 ♂♂ and 3 ♀♀, Sierra Maestra, Oriente Prov.; 10–20 July, 1922; C. H. B. and S C. B. 1 ♀, Pico Turquino, Oriente Prov.; 1 Aug., 1935; 4000–6000 ft ; J A. 1 ♂, Pico Turquino, Oriente Prov.; 10–29 June, 1936; 3750 ft.; J A.

Genus Melormenis Metcalf

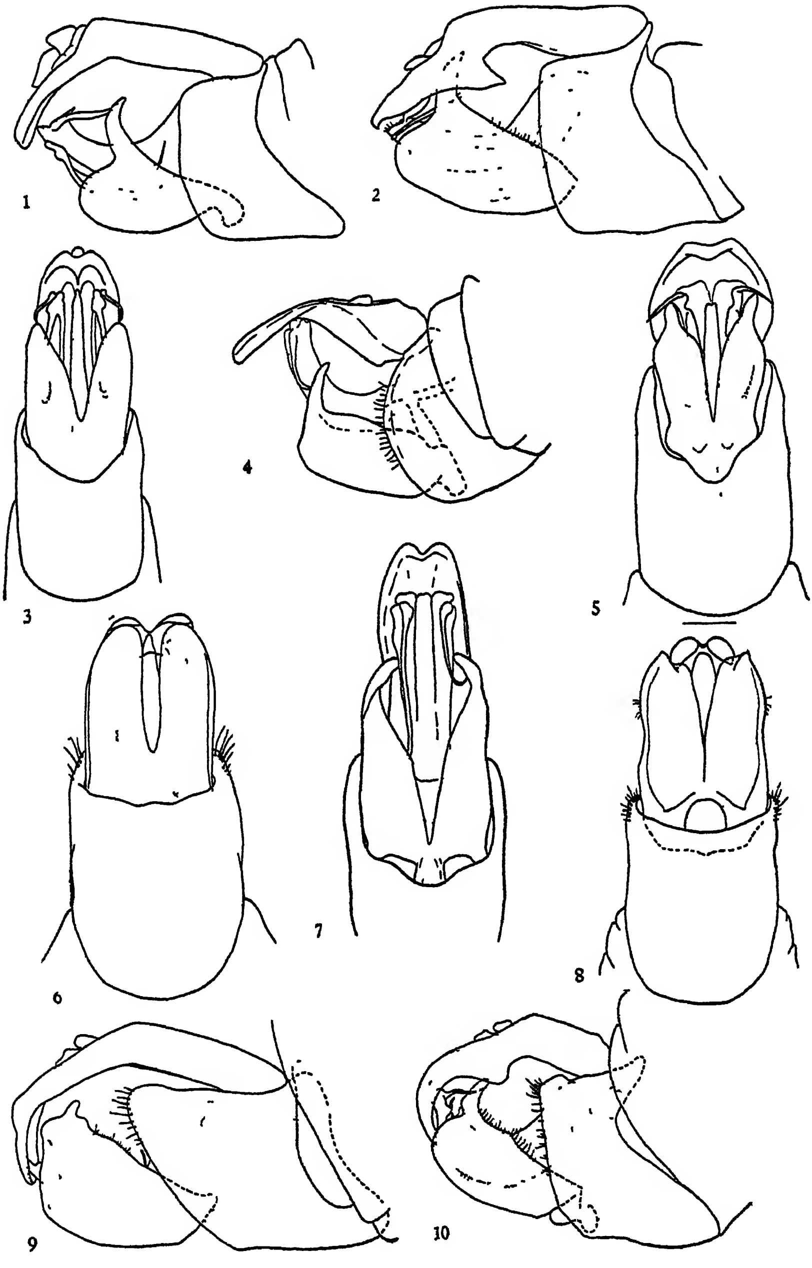
Melormenis Metcalf 1938a: 395. Nom. nov. for *Ormenis* Melichar nec *Ormenis* Stål.

Orthotype *Ormenis antillarum* Kirk. (*Cicada quadripunctata* Fabr).

EXPLANATION OF PLATE XI

Lateral and Ventral Views of Male Genitalia

Fig. 1 *Cyarda fuscifrons* Metc. and Brun. Fig. 2. *Cyarda melichari* Van D. Fig. 3. *Cyarda fuscifrons* Metc. and Brun. Fig. 4. *Leocerus fuscus* Metc. and Brun Fig. 5. *Cyarda melichari* Van D. Fig. 6. *Planodascalia viridicosta* Metc. and Brun. Fig. 7. *Leocerus fuscus* Metc. and Brun. Fig. 8. *Planodascalia fusca* Metc. and Brun. Fig. 9 *Planodascalia viridicosta* Metc. and Brun Fig. 10. *Planodascalia fusca* Metc and Brun.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This genus was proposed for those species of flatids closely related to *Cicada quadripunctata* Fabr. They may be characterized very briefly as follows: Crown very short, frons longer than broad, tegmina triangular; apical margin truncate, apical and sutural angles nearly equal, with a single subapical line rather remote from apical margin, nearly parallel and with most of the longitudinal veins forking beyond the subapical line; costal margin not as broad as costal cell at its widest point.

As thus constituted this genus would have a wide distribution in eastern North America through Mexico and the West Indies as far south as Argentina. It is the largest genus in the present collection, containing nine species.

Melormenis variegata n. sp.

(Pl. V, figs. 2, 5; Pl. XIII, fig. 6)

This is a medium-large species of *Melormenis* with the color chiefly blackish fuscous variegated with ochraceous buff. In structural characters it is very close to *Melormenis siboney*, but the genitalia are very distinct; genital plates short and broad, dorsal tooth distinctly removed from apical margin; aedeagus stout; apical spines short, stout, strongly curved; subapical spines short, stout, strongly curved, about same length as apical spines; anal segment slender and spatulate posterior to anal style, trough-shaped toward apex, lateral processes small, broadly rounded; median process wanting.

Holotype ♂: Pico Turquino, Oriente Prov.; 10–29 June, 1936; J. A. *Allotype* ♀: Naga, Oriente Prov.; 7 July, 1922; S. C. B. and C. H. B. *Paratypes:* 3 ♂♂, Sierra Maestra, Oriente Prov.; 7–20 July, 1922; C. H. B. and S. C. B. 4 ♂♂, Nagua, Oriente Prov.

Melormenis frigida n. sp.

(Pl. XII, figs. 6, 7)

This is one of the most strikingly colored of the species of *Melormenis* of Cuba. Typically the head, except compound eyes, and pronotum are yellowish green; tegmina are largely fuscous brown with claval suture, some large spots on the shoulder, and two large spots on costal margin yellowish green; costal spots frequently fade to whitish; compound eyes and mesonotum tawny; in some specimens, however, the fuscous areas of the wings are reduced to a broad triangle extending from apical margin to base with dorsal margin along the calval suture and ventral margin extending from about the middle of clavus to costal angle; legs and ventral areas usually ochraceous buff.

EXPLANATION OF PLATE XII

Lateral and Ventral Views of Male Genitalia

Fig. 1. *Melormenis pruinosa cubana* Metc. and Brun. Fig. 2. *Melormenis pruinosa cubana* Metc. and Brun. Fig. 3. *Ormenana punctata* Metc. and Brun. Fig. 4. *Melormenis pruinosa* Say. Fig. 4a. *Melormenis pruinosa* Say. Fig. 5 *Melormenis inconspicua* Metc. and Brun. Fig. 6. *Melormenis frigida* Metc. and Brun. Fig. 7. *Melormenis frigida* Metc. and Brun. Fig. 8. *Melormenis maestralis* Metc. and Brun. Fig. 9. *Melormenis asymmetrica* Metc. and Brun. Fig. 10. *Melormenis persea* Metc. and Brun. Fig. 11. *Melormenis persea* Metc. and Brun


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Head including compound eyes not as wide as pronotum; face elongate; median carina very indistinct; mesonotum large; tegmina elongate.

Male genitalia with pygofer short and broad; genital plates short, broad, about one and one-half times as long as greatest width excluding elongate dorsal tooth; aedeagus broad, nearly straight; apical spines short, preapical spines nearly twice as long; subapical spines strongly curved basad; anal segment elongate; lateral angles inconspicuous.

Length to apex of tegmina: ♂, 8.40 mm.; ♀, 9.80 mm.

Holotype ♂: Sierra Maestra, Oriente Prov.; 10–20 July, 1922; 2800–3700 ft ; C. H. B. and S. C. B. *Allotype* ♀ : Santiago de las Vegas, Habana Prov., on mango. *Paratypes:* 2 ♀ ♀, Santiago de las Vegas, Habana Prov.

Melormenis inconspicua n. sp.
(Pl. IV, figs. 9, 12; Pl. XII, fig. 5)

Typically this is a medium large species of *Melormenis* with the basal area of clavus and the apical area of tegmina blackish or blackish fuscous with a few smaller spots of blackish fuscous on basal area of corium; head and mesonotum chiefly tawny, pronotum and basal area of tegmina greenish; venter and legs chiefly tawny.

Crown short and broad; face about as broad as long, the lateral margins strongly elevated, and the dorsal margin with a distinct transverse elevated ridge; pronotum truncately projecting to anterior margin of compound eyes; median carina fairly distinct, a pair of deeply impressed points either side; mesonotum large, median and intermediate carinae distinct; tegmina narrow, elongate, the apical margin distinctly sinuate; apical angle somewhat produced.

Male genitalia with genital plates broad, elongate, with dorsal tooth near apex; aedeagus with apical spines short; preapical spines about twice as long as apical; subapical spines strongly recurved; a large basal projection; anal segment with ventral margin broadly triangularly produced; apical projection elongate, broadly flattened.

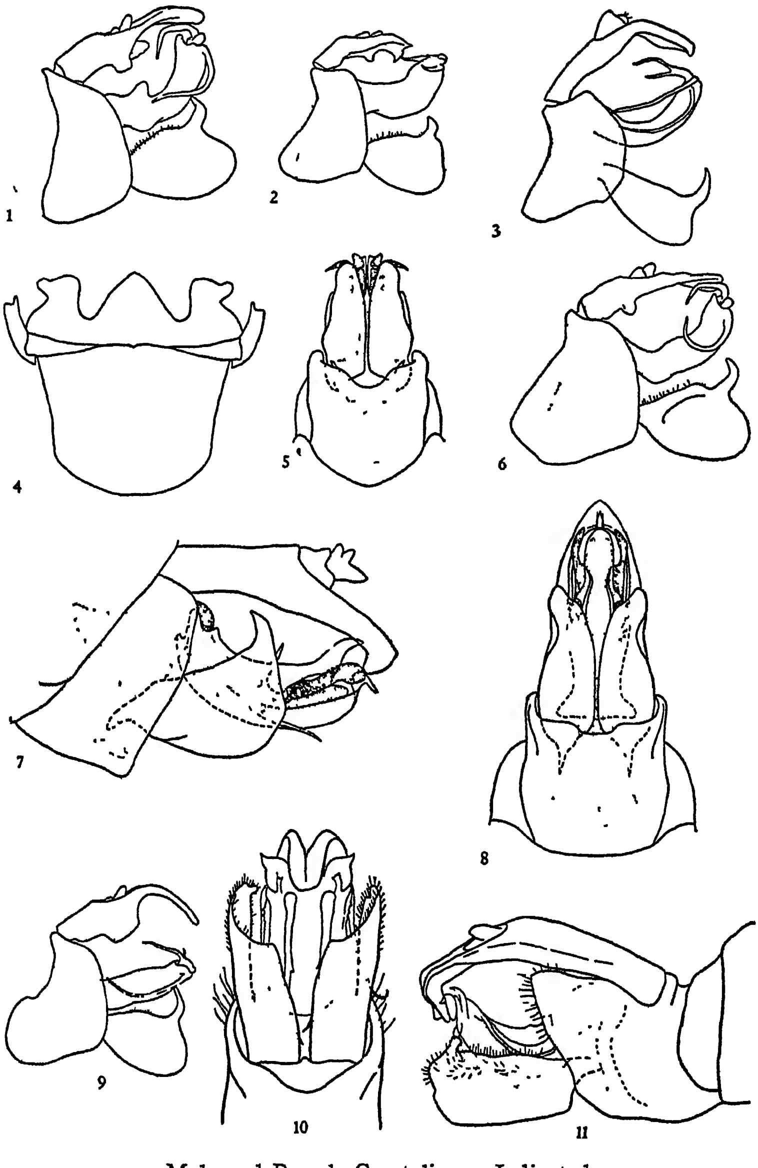
Length to apex of tegmina: 9.10 mm.

Holotype ♂ : Pico Turquino, Oriente Prov.; 20 July, 1922; 5000–5500 ft ; S. C. B. and C. H. B. *Allotype* ♀ : Loma del Gato, Sierra del Cobre, Oriente Prov.; 1–3 Oct., 1935; 2600–3325 ft.; J. A. and S. C. B. *Paratypes:* 1 ♂, Sierra Maestra, Oriente Prov , 10–20 July, 1922; 3000–4250 ft.; C. H. B. and S. C. B. 1 ♀, Sierra Maestra, Oriente Prov., 10–20 July, 1922; 3000–4250 ft.; C. H. B. and S. C. B.

Melormenis maestralis n. sp.
(Pl. XII, fig. 8)

This is a large blackish species with the head, pronotum, legs, and costal margin of tegmina light ochraceous buff. In general it resembles a dark *pruinosa* with costal margin more abruptly paler and distinct genitalia.

Crown very short, the produced pronotum reaching almost to anterior margin; face slightly longer than broad, the lateral margins strongly elevated; pronotum ecarinate, broadly incised posteriorly;



Male and Female Genitalia, as Indicated

Fig. 1. *Melormenis siboney* Metc. and Brun. ♂. Fig. 2. *Ormenana nana* Metc. and Brun. ♂. Fig. 3. *Cyarda haitensis* Metc. and Brun. ♂. Fig. 4. *Planodascalia aguayoi* Metc. and Brun. ♀. Fig. 5. *Melormenis asymmetrica* Metc. and Brun. ♂. Fig. 6. *Melormenis variegata* Metc and Brun. ♂. Fig. 7. *Ormenaria rufifascia* Walk. ♂. Fig. 8 *Ormenaria rufifascia* Walk. ♂. Fig. 9. *Ormenana fusca* Metc. and Brun. ♂. Fig. 10. *Ormenis cubensis* Metc and Brun. ♂. Fig. 11. *Ormenis cubensis* Metc. and Brun. ♂.

mesonotum with dorsal surface flattened and abruptly separated from lateral areas; tegmina elongate, the apical margin broadly rounded.

Male genitalia with genital plates short and broad, dorsal tooth elongate, somewhat acute, curving cephalad; aedeagus elongate, slender, with elongate apical spines; subapical spines elongate with apex abruptly curved dorsad; anal segment with an elongate slender ventral tooth.

Length to apex of tegmina: 7.000–8 50 mm.

Holotype ♂: Pico Turquino, Oriente Prov., 10–29 June, 1936; 3750 ft.; J. A. *Allotype* ♀: Pico Turquino, Oriente Prov.; Oct., 1936; 3000 ft ; J. A. *Paratypes:* 2 ♂♂, Sierra Maestra, Oriente Prov.; 10–20 July, 1922; 3500–3800 ft.; S. C. B. and C. H. B. 1 ♂, Pico Turquino, Oriente Prov.; 20 July, 1922; S. C. B. and C. H. B. 2 ♂♂, Pico Turquino, Oriente Prov.; Oct., 1936; 3000 ft.; J. A. 3 ♀♀, Sierra Maestra, Oriente Prov.; 10–20 July, 1922; 1800–3300 ft.; S C. B. and C. H. B. 1 ♀, Loma del Gato, Sierra del Cobre, Oriente Prov ; 1–2 Oct., 1935; 2600–3325 ft.; J. A. and S. C B. 1 ♀, Pico Turquino, Oriente Prov.; Oct., 1936; 3000 ft.; J. A. 1 ♀, Jarahueca, Oriente Prov.; 14–18 July, 1927; S. C. B.

Melormenis persea n. sp.

(Pl. IV, figs. 7, 10; Pl. XII, figs. 10, 11)

This is a small species with a pale head and prothorax and fuscous mesonotum and tegmina. Tegmina are almost completely covered with a pale bluish pruinescence

Head including eyes about as wide as pronotum; crown very short, face elongate, the whole surface reticulate; lateral margins only slightly elevated; pronotum short, anterior margin parabolic, projecting slightly cephalad of anterior margin of compound eyes; posterior margin almost rectangular; mesonotum large, the surface smooth, carina inconspicuous; tegmina elongate, narrow; subapical line inconspicuous and irregular.

Male genitalia with pygofer short and broad; genital plates about twice as long as greatest width, dorsal tooth elongate, slightly recurved with a basal projection; aedeagus elongate, slender, the apical spines less than half as long as preapical; subapical spines longer than apical, slightly curved; a midventral, elongate tooth directed caudad

General color of head, pronotum, legs, and venter ochraceous brown; compound eyes chiefly reddish brown; mesonotum fuscous, lateral areas blackish fuscous; tegmina chiefly fuscous; inconspicuous black areas at base and at shoulders; costal margin usually indistinctly paler

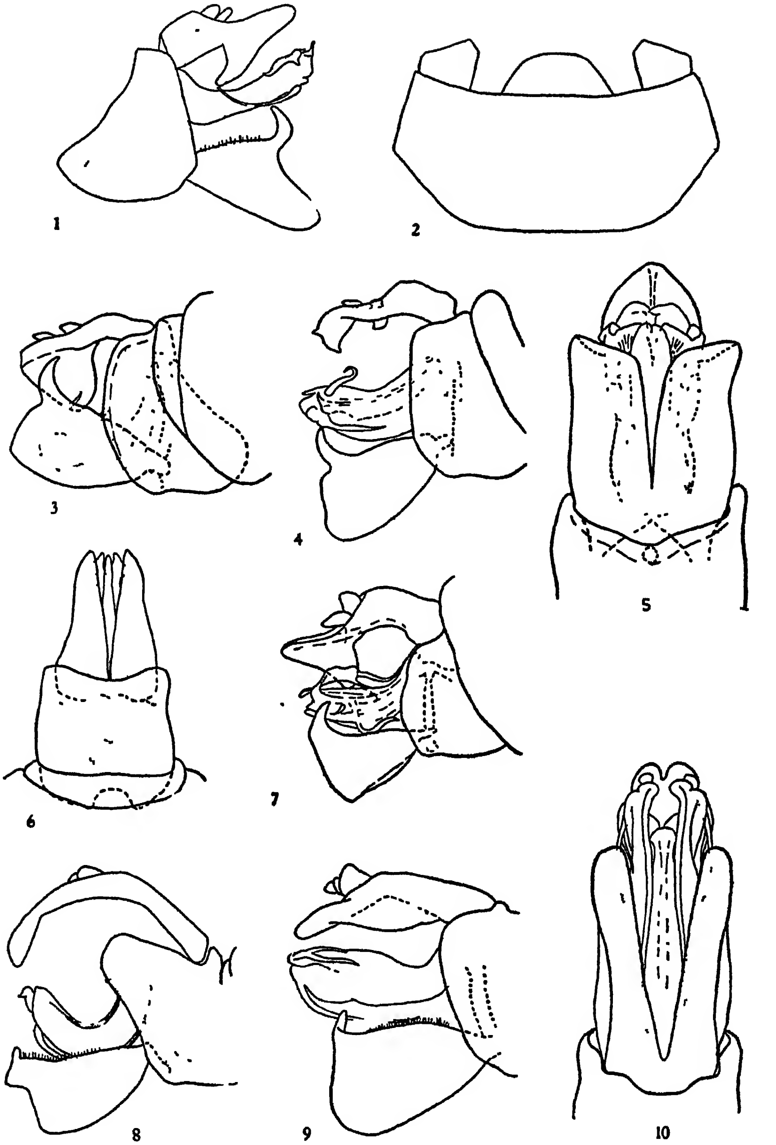
Length to apex of tegmina: ♂, 6.80 mm.; ♀, 8.40 mm.

Holotype ♂: Santiago de las Vegas, Habana Prov. *Allotype* ♀: Santiago de las Vegas, Habana Prov., on *Persea*; 18 July, 1928, S. C. B.

Melormenis asymmetrica n. sp.

(Pl. II, fig. 6; Pl. IV, figs. 8, 11; Pl. XII, fig. 9, Pl. XIII, fig. 5)

This is a moderate-sized to rather large species of *Melormenis* with the pronotum, head, and basal three-quarters of the tegmina light olive green; very distinct male genitalia



Male and Female Genitalia, as Indicated

Fig. 1. *Ormenoides subflava* Metc. and Brun. ♂. Fig. 2. *Planodascalia obscura* Metc. and Brun. ♀. Fig. 3. *Byllisana brunnea* Metc. and Brun. ♂. Fig. 4. *Ormenana linki* Heid. and Osb. ♂. Fig. 5. *Dakshiana katharina* Metc. and Brun. ♂. Fig. 6. *Byllisana brunnea* Metc. and Brun. ♂. Fig. 7. *Dakshiana katharina* Metc. and Brun. ♂. Fig. 8. *Planodascalia obscura* Metc. and Brun. ♂. Fig. 9. *Carthaeomorpha balloui* Metc. and Brun. ♂. Fig. 10. *Carthaeomorpha balloui* Metc. and Brun. ♂.

Crown very short with a projecting pronotum reaching anterior margin; face elongate, the lateral margins strongly curved; median carina distinct, sometimes short; tegmina elongate with costal and sutural margins somewhat sinuate; apical and sutural angles strongly rounded; subapical line parallel to apical margin, about twice as far from apical margin as width of costal area; hind tibiae with two spines.

Male genitalia with pygofer short and broad; genital plates short and broad with a rather short, middorsal, recurved tooth; anal segment asymmetrical, short with a lateral lobe below on each side at about level of anal style, this lobe well developed and directed obliquely caudad on right and usually shorter and bent more or less cephalad on left side; aedeagus broad with a strong dorsal crest, a single pair of apical spines broad and flat towards center and a pair of elongate, moderately recurved, somewhat flattened subapical spines.

General color of head, pronotum, face, legs, venter of abdomen, and basal three-fourths of tegmina light olive green, more or less clouded with fuscous; eyes and mesonotum tawny; eyes clouded with fuscous on anterior margin, mesonotum clouded with fuscous on lateral margins; basal area of tegmina more or less clouded and spotted with fuscous, costal margin clouded with fuscous; apical area strongly clouded with fuscous, which may extend into center of corium.

Length to apex of tegmina: ♂, 6.50 mm.; ♀, 9.00 mm.

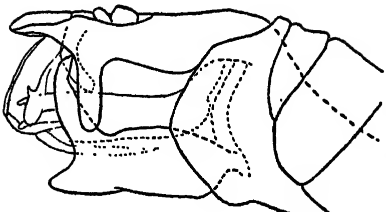
Holotype ♂: Santiago de las Vegas, Habana Prov., on *Pisonia aculeata* Linné; 28 July, 1932; A. R. O. *Allotype* ♀: Santiago de las Vegas, Habana Prov., on *Cordia colococca*, 3 Aug., 1932; S. C. B. *Paratypes:* 2 ♀♀, Santiago de las Vegas, Habana Prov.; S. C. B. 1 ♀, Colon, Matanzas Prov.; 15 Nov., 1922; A. C. 1 ♂, Isle of Pines; 4–12 Sept., 1926; S. C. B. and L. B. 1 ♀, Isle of Pines, 4–12 Sept., 1926; S. C. B. and L. B. 1 ♀, El Cano, Habana Prov.; 21 Sept., 1928; S. C. B. 1 ♂, El Fraile, Pinar del Rio Prov. 1 ♀, El Fraile, Pinar del Rio Prov. 1 ♂, Santiago de las Vegas, Habana Prov.; 16 July, 1920. 1 ♂, Barrio Caobilla, Camagüey Prov.; 23–25 June, 1927; J. A. 1 ♂, Vinales, Pinar del Rio Prov.; 15 Apr., 1930; S. C. B. 1 ♀, Santiago de las Vegas, Habana Prov.; 7 July, 1932; S. C. B. and A. R. O. 1 ♀, Jaronu, Camagüey Prov.; 3 Apr., 1932; L. C. S. 1 ♂, Wajay, Habana Prov., on *Casuarina*, 31 Aug., 1928; S. C. B. 2 ♀♀, Wajay, Habana Prov., on *Casuarina*, 31 Aug., 1928; S. C. B. 1 ♂, Cobre, Oriente Prov.; 5 Oct., 1928; F. S. and S. C. B. 1 ♀, Santiago de las Vegas, Habana Prov. 1 ♀, Oriente Prov.

Melormenis asymmetrica has been found on *Annona reticulata*, *Casuarina equisetifolia*, *Cedrela mexicana*, *Dichrostachys glomerata* (rather scarce), *Psidium guajaba*, and several other common plants.

EXPLANATION OF PLATE XV

Lateral and Ventral Views of Male Genitalia

Fig. 1. *Flatoidinus acutus* Uhl. Fig. 2. *Flatoidinus obscurus* Metc. and Brun. Fig. 3. *Flatoidinus acutus* Uhl. Fig. 4. *Flatoidinus obscurus* Metc. and Brun. Fig. 5. *Flatarissa humeralis* Metc. and Brun. Fig. 6. *Flatarina aguiari* Metc. and Brun. Fig. 7. *Flatidula pallescens* Metc. and Brun. Fig. 8. *Flatarissa humeralis* Metc. and Brun. Fig. 9. *Flatidula pallesceus* Metc. and Brun.



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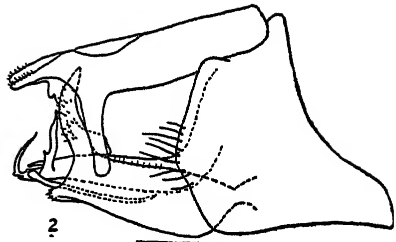

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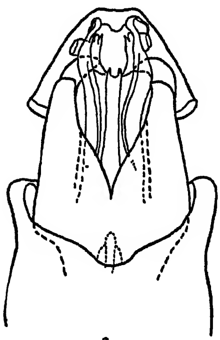

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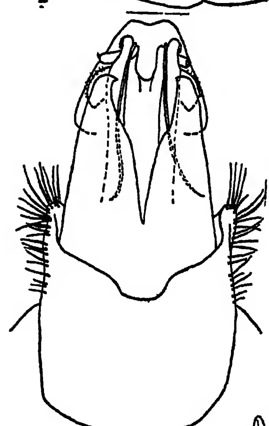

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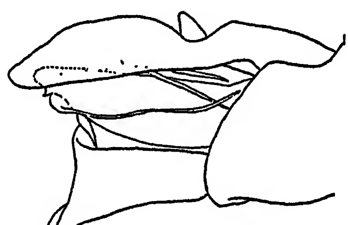

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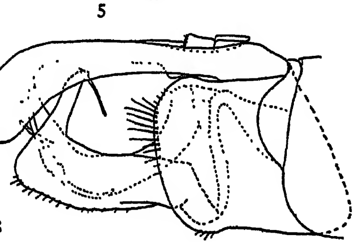

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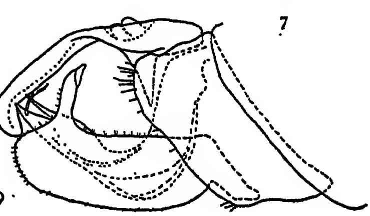

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Melormenis pruinosa Say

(Pl. XII, figs. 4, 4a)

Flata pruinosa Say 1830a: 237.
Ormenis pruinosa Melichar 1902a: 71, Pl. V, fig. 7.

This is one of the most common species in eastern North America, ranging from Ontario to Florida, west to the Great Plain states, south to Texas, Arizona, and California to Mexico and Cuba. In Cuba it has a wide distribution, being recorded from all of the provinces where extensive collecting has been done. It is very variable in size and general coloration. The variation in coloration is due chiefly to the presence or absence of a bluish white pruinescence.

Melormenis pruinosa cubana n. subsp.

(Pl. IV, fig. 13; Pl. XII, figs. 1, 2)

Crown short and broad, covered for about half of its length by projecting pronotum; face elongate, lateral margins strongly arcuate; dorsal margin slightly longer than clypeal margin; median carina very variable, sometimes almost percurrent, at other times greatly reduced; tegmina with subapical line evident unless covered by the waxy pruinescence.

Male genitalia with pygofer short and broad; genital plates about twice as long as broad, an elongate, slightly recurved dorsal tooth; aedeagus long and slender with three pairs of spines; apical spines about half as long as preapical spines; subapical spines elongate, slender, strongly recurved.

Color very variable, due to a light bluish white pruinescence typically covering most of tegmina; color of head, pronotum, the center of thorax and abdomen including legs, light ochraceous buff; mesonotum, tegmina, and dorsum of abdomen chiefly fuscous; costal margin and claval suture usually distinctly paler with an indefinite paler area just beyond the discal cell; this pale area usually includes a round fuscous spot.

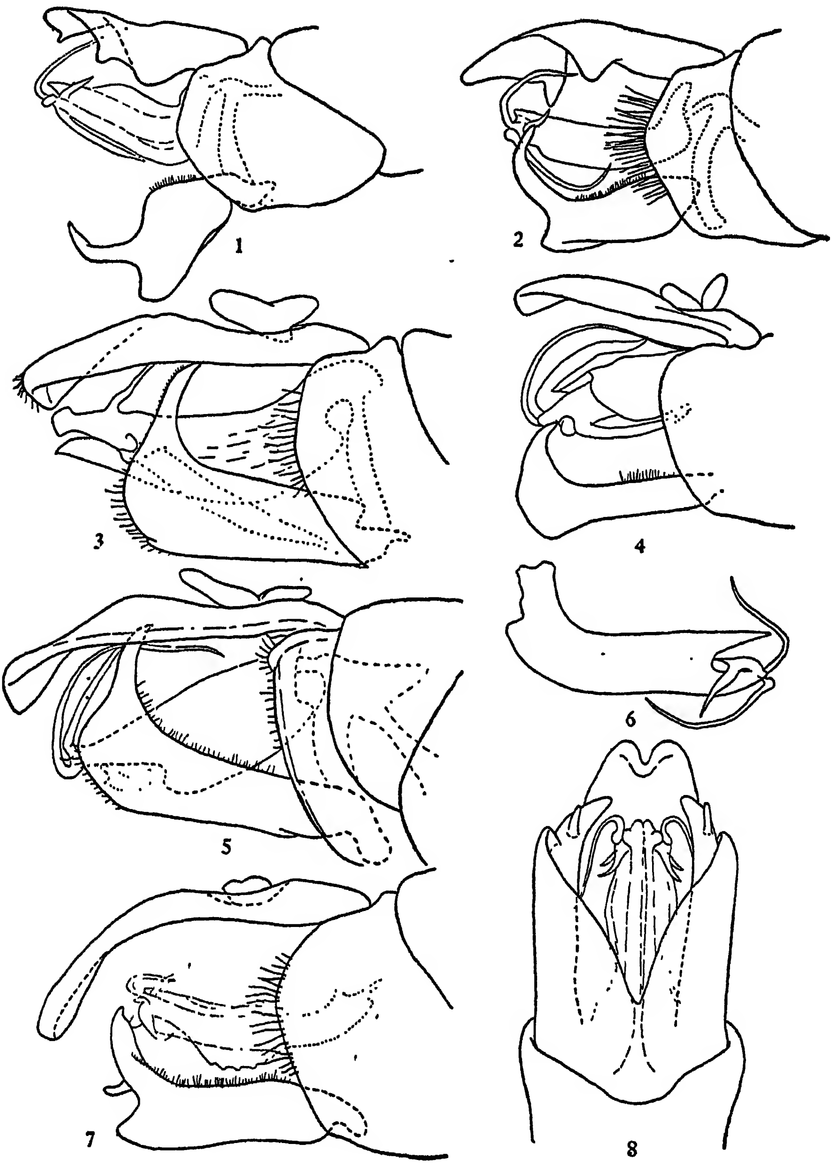
Length variable, smallest males to apex of tegmina, 5.00 mm.; largest females, 8.00 mm.

This subspecies seems to be widespread and abundant in Cuba, having been collected in practically all localities where extensive collecting has been done. We have examined specimens taken on *Annona reticulata*, *Coffea arabica*, *Coccolobis uvifera*, *Psidium guajava*, and other plants.

Melormenis siboney n. sp.

(Pl. XIII, fig. 1)

This is a rather large species of *Melormenis* with the tegmina chiefly blackish fuscous, variegated with light yellowish green. Typically there are two large semi-translucent spots on the costal margin, one near middle of costal area and one just before the apical line extending inward to near middle of corium; clavus and basal half of corium chiefly yellowish green with large irregular spots of blackish fuscous; lateral areas of mesonotum are chiefly blackish fuscous, the median area tawny fading to ochraceous tawny.



Lateral and Ventral Views of Male Genitalia

Fig. 1. *Flatoidinus dotatus* Mel. Fig. 2. *Flatoidinus olivaceus* Metc. and Brun. Fig. 3. *Pseudoflatoides lichenoides* Metc. and Brun. Fig. 4. *Pseudoflatoides tortrix* Guér.-Mén. Fig. 5. *Pseudoflatoides fasciculosus* Mel. Fig. 6. *Flatoidinus punctatus* Metc. and Brun. Fig. 7. *Flatoidinus pallescens* Metc. and Brun. Fig. 8. *Flatoidinus pallescens* Metc. and Brun.

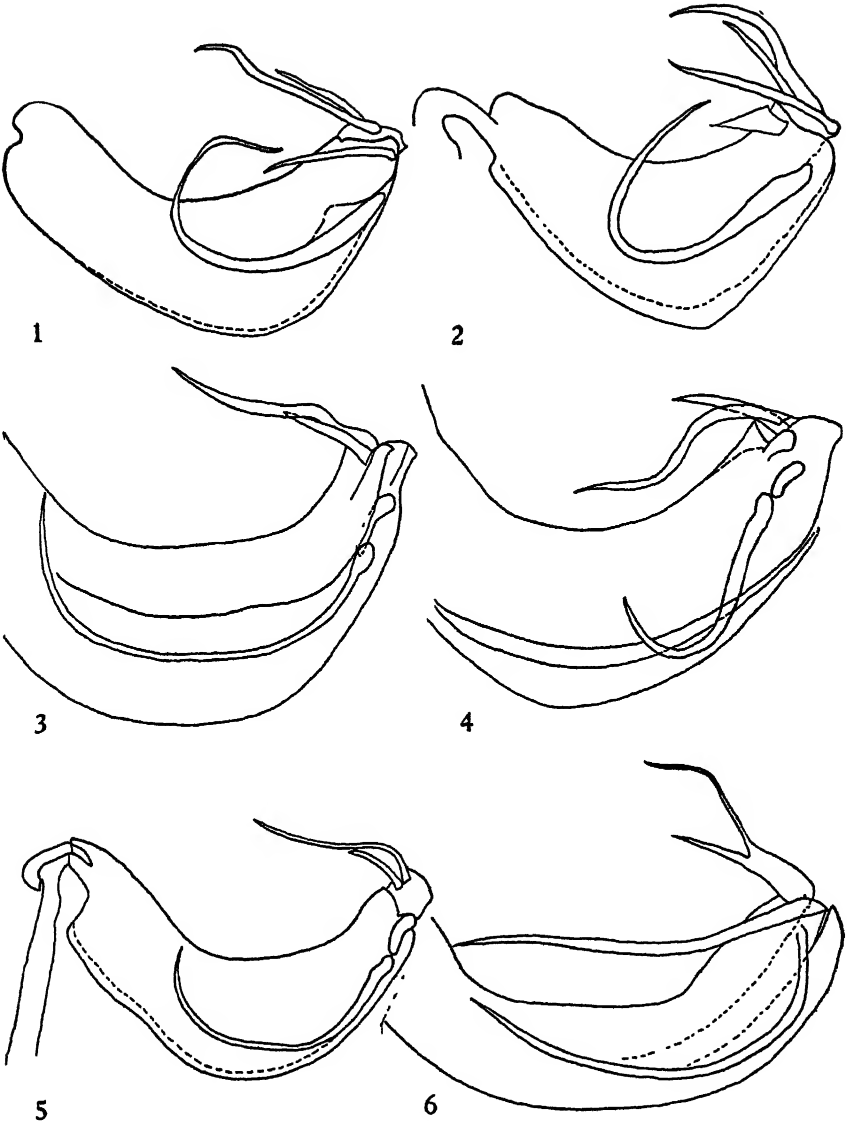
Crown very short, the anterior margin of pronotum extending almost to anterior margin of crown, leaving only the lateral areas exposed; face slightly broader than long, the lateral margins strongly elevated, the dorsal transverse carina evident; median carina evident dorsad; pronotum short and broad, the anterior margin strongly produced; lateral margins very short; posterior margin more broadly sinuate; mesonotum large, the intermediate carinae strongly elevated; tegmina typical, the subapical line evident; costal margins somewhat sinuate; most of longitudinal veins branched beyond subapical line.

Male genitalia with pygofer short and broad, the anal segment narrow, elongate with quadrate lateral processes and a distinct median process; genital plates nearly twice as long as broad, the apical margin broadly rounded, the dorsal tooth placed well before apex, elongate, slightly recurved; aedeagus elongate, nearly cylindric, with a dorsal projection on basal third; apical spines elongate, decurved; lateral processes sometimes asymmetrical, the one on the right side directed caudad and the one on the left side shorter, quadrate, directed ventrad; subapical spines longer than apical, distinctly curved.

Head, venter, and legs chiefly pale warm buff; compound eyes chiefly russet brown with a blackish mark dorsally; face somewhat clouded with pale fuscous; pronotum pale greenish yellow; mesonotum with central area chiefly ochraceous tawny, the lateral areas blackish fuscous, fading to ochraceous tawny, on tegulae; tegmina pale greenish yellow on basal half of corium and clavus, heavily spotted with fuscous, the apical area almost completely fuscous with exception of semi-translucent costal spots.

Length to apex of tegmina: 6.50–7.00 mm.

Holotype ♂: Loma del Gato, Sierra de Cobre, Oriente Prov.; 24–30 Sept., 1935; J. A., S. C. B. and L. C. S. *Allotype* ♀: Loma del Gato, Sierra de Cobre, Oriente Prov.; 24–30 Sept., 1935; J. A., S. C. B. and L. C. S. *Paratypes:* 2 ♀♀ and 1 ♂, Loma del Gato, Sierra de Cobre, Oriente Prov.; 1–2 Oct., 1935; 2600–3325 ft.; J. A. and S. C. B. 1 ♀, Camagüey, Camagüey Prov.; 22 July, 1923; J. A. 2 ♀♀, Camagüey, Camagüey Prov.; 30 July, 1923; J. A. 1 ♀, and 1 ♂, Nagua, Oriente Prov.; 7 July, 1922; C. H. B. and S. C. B. 7 ♀♀ and 1 ♂, Jaronu, Camagüey Prov.; 21 Aug., 1934; L. C. S. 2 ♂♂ and 1 ♀, Sierra Maestra, Oriente Prov.; 2000–2600 ft.; C. H. B. and S. C. B. 1 ♀, Buenos Aires, Trinidad Mts., Las Villas Prov. 1 ♀, Somorrostro, Habana Prov.; 16 Aug., 1936; L. C. S. 1 ♀, Puna, Camagüey Prov.; 15 Aug., 1932; L. C. S. 1 ♀, Jarahueca, Oriente Prov.; 14–18 July, 1927; S. C. B. 1 ♂, Pan de Matanzas Mts., Matanzas Prov.; 12 June, 1932; S. C. B., A. R. O. and L. C. S. 1 ♀, Oriente, Oriente Prov.; 12 Sept., 1934; L. C. S. 1 ♂, Sierra Rangel Mts., Pinar del Rio Prov.; 29 Aug., 1927; 1500 ft.; J. A. and S. C. B. 1 ♂, Pico Turquino, Oriente Prov., 10–29 June, 1936; 3750 ft.; J. A. 1 ♀, Guantánamo, Oriente Prov.; 28 Nov., 1931; L. C. S. 1 ♀, Las Animas, Pinar del Rio Prov.; 3–5 Sept., 1934; 1500 ft.; S. C. B. and A. R. O. 1 ♀, Nibuyon, Oriente Prov.; 1 Aug., 1935; J. N.



Lateral Views of Aedeagi of Genus *Cyarda*

Fig. 1. *Cyarda walkeri* Metc. Fig. 2. *Cyarda acuminipennis* Spin. Fig. 3. *Cyarda fuscifrons* Metc. and Brun. Fig. 4. *Cyarda cubensis* Metc. and Brun. Fig. 5. *Cyarda acutissima* Metc. and Brun. Fig. 6. *Cyarda haitensis* Metc. and Brun.

Genus **Cyarda** Walker

Cyarda Walker 1858b: 121. [Gen. n.]
Melichar 1902a: 133. [Described, key to species.]
Melichar 1923a: 91. [Described, catalogue of species.]
Metcalf 1923a: 151. [Key, key to species.]
Dozier 1928a: 119. [Described.]
Metcalf 1938a: 406. [Note.]

Haplotype *Cyarda difformis* Walk.

This is one of the most distinct genera of the family Flatidae. It may be readily recognized by the shape of the tegmina which are elongate, narrow, wider on the basal third and gradually constricted toward the apex. The apical margin is usually oblique and distinctly sinuate. This genus might be confused with the genus *Mistharnophantia* Kirk., but in that genus the tegmina are much shorter, being very little longer than broad, whereas in the genus *Cyarda* Walk. the tegmina are three or four times as long as broad.

Nine species are at present assigned to this genus. Three of these species are found in Africa and Madagascar and perhaps belong to some other genus. Six species are American and range from the southern U. S. through the West Indies to northern South America, including Venezuela and Dutch Guiana.

Cyarda acuminipennis Spinola

(Pl. III, figs. 1, 2; Pl. X, figs. 2, 5; Pl. XVII, fig. 2)

Cyarda acuminipennis Spinola 1839b: 445.
Melichar 1902a: 134; Pl. VII, fig. 12.
Metcalf 1923a: 151, Pl. 41, fig. 40; Pl. 48, fig. 139.

If we have correctly identified this species, it is the largest species of *Cyarda* from Cuba. The total length from apex of head to apex of abdomen is 7 to 8 mm., to apex of tegmina 10 to 12 mm. Melichar gives 10 mm. the total length of body and Spinola gives four lines as the length from apex of head to apex of abdomen. This species was originally described from Santo Domingo and has been recorded from Jamaica and is also found in southern Florida. It seems to be one of the most abundant species in Cuba. Specimens in our collection vary greatly in color from ochraceous tawny to ochraceous buff. In the ochraceous tawny specimens the apical half of tegmina, principal veins in basal half, and crossveins in costal margin are heavily clouded with blackish fuscous.

Crown broad, fully twice as broad as its median length; median carina very obtuse, frons about as broad as its median length, narrowed on clypeal margin and dorsal margin; pronotum broad, broadly extending cephalad to anterior margin of compound eyes; mesonotum quadrate; tegmina nearly four times as long as basal width; costal and sutural margins somewhat sinuate; apical margin broadly and shallowly sinuate; sutural and costal angles broadly rounded.

Male genitalia with the anal segment heavy; apical vertical portion broadened toward apex; genital plates somewhat elongate, dorsal tooth heavy, obtuse at apex; aedeagus elongate, somewhat slender; apical spines more than half as long as preapical; preapical spines very broad on basal third; apical two-thirds gradually acuminate, strongly

curved; subapical spines about as long as apical, straight and stouter; ventral spines elongate, U-shaped, the two limbs nearly equal in length.

Widely distributed in Cuba, having been collected from the principal areas where extensive collections have been made and occurring to 1500 feet in the Sierra Rangel Mountains.

Cyarda acutissima n. sp.

(Pl. III, fig. 3; Pl. X, figs. 1, 3; Pl. XVII, fig. 5)

This is a small *Cyarda* with tegmina very broad at base, much narrowed caudad, and produced into an acute apical area with apex rounded and apical margin fading indefinitely into sutural margin.

Vertex broad, about twice as broad as its median length; median carina broad, lateral margins broadly elevated; frons about as long as broad, lateral margins narrowly elevated; clypeal margin as broad as dorsal margin; pronotum short and broad, strongly projecting cephalad to middle of compound eyes; mesonotum quadrate, intermediate carinae usually strongly elevated; legs short and stout; tegmina broad at base, strongly narrowed beyond shoulders; apical area only about half as wide as basal area; costal margin strongly sinuate; apical area roundly acute; apical margin not sharply separated from commisural margin.

Male genitalia with anal segment elongate, slender; apical portion elongate, slender, almost at right angles to dorsal area; genital plates broad and short, dorsal tooth rather acute; aedeagus broad and stout, the apical spines about half as long as the preapical; preapical spines very slender; subapical spines short, stout, obtuse; ventral spines about one-half as long as aedeagus, broadly curved.

General color ochraceous tawny; brownish or blackish fuscous on crown, pronotum and mesonotum, in pustulate area of clavus and in apical area of tegmina; ten to twelve small round blackish spots in costal area and five or six in median area of tegmina.

Length to apex of tegmina: ♂, 6.50 mm.; ♀, 7.00 mm.

Holotype ♂: Herradura, Pinar del Rio Prov.; 20 Feb., 1932; S. C. B. and A. R. O. *Allotype* ♀: Herradura, Pinar del Rio Prov.; 20 Feb., 1932; S. C B. and A. R. O. *Paratypes:* 2 ♂♂, Santa Fe, Isle of Pines; 8 May, 1933; A. R. O. 1 ♂, Taco Taco, Pinar del Rio Prov.; 6 Apr., 1922, S. C. B., J. A., and C. H. B. 1 ♀, Kingston, Jamaica; 15 Oct., 1923; C. H. B. 1 ♂, Santa Cruz de los Pinos, Pinar del Rio Prov.; 20 Feb., 1932; S. C. B. and A. R. O. 1 ♂ and 1 ♀, Playa de Marianao, Habana Prov.; 30 Jan., 1927; S. C. B.

Cyarda cubensis n. sp.

(Pl. III, fig. 4, 5; Pl. X, figs. 6, 8; Pl. XVII, fig. 4)

This is a rather small species of *Cyarda* with an elongate narrow crown and distinct male genitalia.

Crown but little broader than long; anterior margin rather obtuse; frons slightly longer than its greatest width, lateral margins strongly elevated; tegmina very broad at base, rather narrow in apical half; apical sinus distinct but not very deep.

Male genitalia with genital plates broad and short, dorsal tooth elongate, slender, acute; anal segment elongate, slender, the deflexed

portion almost as long as basal portion; aedeagus short, stout; apical spines about half as long as preapical, stout and gradually acuminate; preapical spines elongate, gradually acuminate, distinctly undulate; subapical spines very short, stout; ventral spines sickle-shaped, about as long as preapical, a strongly developed midventral process which is about as long as aedeagus.

General color light ochraceous buff, sometimes slightly clouded with tawny in central area of mesonotum; round black spots on tegmina, usually small; tegmina clouded with fuscous.

Length of apex of tegmina: ♂, 7.50 mm.; ♀, 8.00 mm.

Holotype ♂: Calabazar, Habana Prov.; 5 Aug., 1928; S. C. B. *Allotype* ♀: Cape Baragua, Camagüey Prov.; 26–27 June, 1927; S. C. B. and C. F. S. *Paratypes:* 3 ♂♂, Santiago de las Vegas, Habana Prov.; 2 ♀♀, Santiago de las Vegas, Habana Prov.; 1 ♀, Baragua, Camagüey Prov.

Cyarda fuscifrons n. sp.

(Pl. III, figs. 7, 8; Pl. XI, figs. 1, 3; Pl. XVII, fig. 3)

This is one of the smaller species of *Cyarda* with relatively short and broad tegmina and crown elongate but not protuberant. The male genitalia are distinct.

Crown about one and one-half times as broad as its median length; median carina not strongly elevated; lateral margins broadly elevated; frons elongate, longer than greatest width, lateral margins not strongly elevated; pronotum short and broad, nearly four times as broad as its median length; anterior margin projecting to about the middle of compound eyes, rather obtuse; median and intermediate carinae not strongly elevated; mesonotum relatively small, median carina indistinct, intermediate carinae not strongly elevated; tegmina short and broad, apical sinus deep, the costal and inner angles strongly rounded.

Male genitalia with the anal segment slender, elongate, the ventral projection short and slender; genital plates broad and short, dorsal tooth elongate, slightly recurved; aedeagus slender, the apical spines very short, less than one-half as long as preapical; preapical spines slender, the apices slightly undulate; subapical spines short, slender, triangular; ventral spines very elongate, approximately as long as aedeagus, broadly curved with the base bulbous.

General color light ochraceous brown; clypeus, the central areas of crown, pronotum, mesonotum tawny; tegmina light ochraceous buff with basal portion of costal area and apical area infuscated with scattered round black spots in costal and central areas; anterior margin of head blackish fuscous.

Length to apex of tegmina: ♂, 7.75 mm.; ♀, 8.00 mm.

Holotype ♂: Santiago de las Vegas, Habana Prov., on *Casuarina*, 29 May, 1934; S. C. B. *Allotype* ♀: Santiago de las Vegas, Habana Prov., on *Casuarina*, 29 May, 1934; S. C. B. *Paratypes:* 1 ♂, Camagüey, Camagüey Prov.; 23–25 June, 1927; J. A. 2 ♂♂, Santiago de las Vegas, Habana Prov. 1 ♂, Bahia de Cochinos, Las Villas Prov 1 ♂, Cape San Antonio, Pinar del Rio Prov.; 13 Apr., 1924; S. C. B. 1 ♂, Playa de Marianao, Habana Prov.; 21 Aug., 1927; S. C. B.

Cyarda haitensis n. sp.

(Pl. XIII, fig. 3; Pl. XVII, fig. 6)

This is a rather large species of *Cyarda* with the crown broad and short. Tegmina broad at base, relatively short and broad at apex with apical sinus distinct. General color ochraceous buff with the apex of the head, the shoulder callosities, the principal veins on basal half of tegmina marked with blackish fuscous. The apical area of the tegmina chiefly fuscous. The crown, pronotum, and mesonotum ochraceous orange.

Male genitalia with pygofer short and broad; anal segment elongate, very slender, the deflexed portion about half as long as basal portion; genital plates about twice as long as broad, the apical tooth rather stout; aedeagus slender, the apical spines stout, bifurcate, the posterior process very slender, nearly twice as long as anterior process; preapical spines elongate, slender, almost as long as aedeagus; subapical spines almost as long as preapical, broadly curved.

Length to apex of tegmina: ♂, 9.50 mm.; ♀, 9.90 mm.

Holotype ♂: Port-au-Prince, Haiti, on *Acacia lutea*, 28 Feb., 1934; E. D. *Allotype* ♀: Port-au-Prince, Haiti, on *Acacia lutea*, 28 Feb., 1934; E. D. *Paratypes:* 3 ♂♂, Port-au-Prince, Haiti, on *Acacia lutea*, 28 Feb., 1934; E D.

Cyarda melichari Van Duzee

(Pl. III, figs. 10, 11; Pl. XI, figs. 2, 5)

Cyarda melichari Van Duzee 1907a: 40. Nom. nov. for *Cyarda punctata* Melichar nec. *Flatoides punctata* Walker.
Cyardi melichari Metcalf 1923a: 151, Pl. 41, fig. 39; Pl. 48, figs. 136, 137. [Key, illustrated.]
Cyarda melichari Dozier 1928a: 120; fig. 28. [Described, illustrated.]

This is one of the smaller *Cyardas* with a narrow elongate crown and frons longer than its greatest width. This species has a wide distribution, having been recorded from the District of Columbia to Mississippi in the southeastern states and in Cuba and Jamaica.

Male genitalia with genital plates short and broad, dorsal tooth short; anal segment elongate, the vertical portion broadly expanded ventrad; apical spines short and broad, subequal; preapical spines elongate, slender, about half again as long as apical, and appears jointed near middle; subapical spines elongate, slender, not as long as preapical; ventral spines stout, strongly recurved, gradually narrowed to apical third, then broadened and acute at apex.

Specimens are at hand from Pinar del Rio and Habana Provinces and the Isle of Pines on beach grasses.

Cyarda walkeri Metcalf

(Pl. III, figs. 6, 9; Pl. X, figs. 4, 7; Pl. XVII, fig. 1)

Cyarda conformis Melichar 1902a: 134. Nec *Flatoides conformis* Walker 1851a: 412.
Cyarda walkeri Metcalf 1923a: 149, 151; Pl. 48, fig. 138. Nom. nov. for *Cyarda conformis* Melichar.

As we understand this species it is one of the smallest species of *Cyarda* with a short broad crown. Colors light ochraceous buff with tegmina with several small round dots. The male genitalia are distinct.

Crown short and broad, nearly three times as broad as its median length, broadly curved on anterior margin; frons about as long as greatest width between the eyes; tegmina relatively short and broad, apical sinus not deep; costal and inner angles not produced.

Male genitalia with the anal segment rather stout; apical vertical portion short and broad; anterior and posterior angles strongly produced; aedeagus stout with apical spines slender, nearly straight; preapical spines elongate, slender, about one-third longer than apical, undulate at apex; subapical spines about same length as preapical, slender, straight; ventral spines long and strongly recurved; genital plates short and rather broad, the dorsal tooth elongate, incurved.

Length to apex of tegmina: ♂, 7.75 mm.

Specimens are at hand from Pinar del Rio, Habana, Matanzas, and Santa Clara provinces.

Genus **Planodascalia** nov.

Orthotype *Planodascalia viridicosta* n. sp.

This genus belongs to that group of the Tribe Selizini which has the tegmina long and narrow, not especially narrowed posteriorly and with two subapical lines parallel to apical margin.

Crown short and broad; frons broader than long with a fairly distinct median carina and lateral margins strongly elevated; pronotum short and broad, but little longer than crown; anterior margin broadly curved, extending cephalad to about anterior margin of compound eyes; posterior margin broadly sinuate nearly parallel to anterior margin; mesonotum large; tegmina elongate, narrow; costal margin slightly sinuate; apical margin nearly straight; sutural angle produced; costal area slightly broader than costal cell; there are two distinct subapical lines; basal subapical line somewhat zigzag, most of longitudinal veins beyond last subapical line bifurcate; hind tibiae with two stout spines near apex.

Planodascalia fusca n. sp.

(Pl. IV, figs. 2, 5; Pl. XI, figs. 8, 10)

This species averages somewhat heavier than *viridicosta* with the body and tegmina chiefly blackish fuscous; costal margin narrowly bordered with pale ochraceous buff and the costal crossveins usually distinctly pale on blackish background.

Head and thorax about as in *viridicosta* with the lateral margins of the face less strongly reflexed; tegmina somewhat broader than in *viridicosta*; tubercles on clavus usually not conspicuous.

Male genitalia with genital plates elongate, about twice as long as greatest width; dorsal tooth elongate, obtuse, somewhat recurved; anal segment elongate with distinct lateral lobes; aedeagus elongate, curved; apical spines broad at base with a distinct tooth, apical portion slender, bent at almost right angles to base; preapical spines short, slender; subapical spines elongate, very slender.

General color blackish fuscous; head and pronotum tawny; eyes tawny, clouded with black; frons somewhat infuscated; tegmina usually blackish fuscous with costal margin narrowly pale.

Length to apex of tegmina: 6.75 mm.

Holotype ♂: Manacas, Las Villas Prov.; 7 June, 1930; S. C. B. *Allotype* ♀: Nagua, Oriente Prov.; 7 July, 1922; S. C. B. and C. H. B. *Paratypes:* 1 ♂, Cape San Antonio, Pinar del Rio Prov.; 13 Apr., 1924; S. C. B. 1 ♀, Guantánamo, Oriente Prov.; 28 Nov., 1931; L. C. S. 1 ♀, Playa Ocujal, Oriente Prov.; 30 July, 1935; J. A.

Planodascalia obscura n. sp.

(Pl. VI, figs. 8, 9; Pl. XIV, figs. 2, 8)

This is a variable species. As far as colorations is concerned superficially it has the same general color as *Bysillana brunnea* Metc. and Brun. The body, legs, and tegmina are ochraceous tawny or tawny with head and tegmina more or less clouded with fuscous or blackish; costal area greenish, fading to ochraceous; however, the tegmina are much longer than in *Bysillana brunnea*, and genitalia are entirely distinct.

Crown very short, not distinctly separated from frons; frons one and one-half times as broad as its median length; lateral margins strongly elevated, broadly curved; dorsal margin slightly longer than ventral margin; pronotum short and broad, anterior margin truncate between compound eyes; posterior margin triangularly incised; mesonotum large, dorsal area broadly flattened; tegmina elongate, narrow, the costal margin broadly sinuate, apical margin broadly truncate; apical and sutural angles subequal; costal membrane wider than costal cell with numerous crossveins; two subapical lines nearly parallel and about the same distance from each other as last subapical line is from apical margin; longitudinal veins mostly bifurcate beyond last subapical line; clavus and shoulders with numerous pustules.

Male genitalia with pygofer short and broad, nearly quadrate; genital plates elongate with a dorsal apical angle quadrately produced with a short obtuse tooth on dorsal angle; aedeagus slender, broadly curved with apical spines elongate, curved, almost as long as aedeagus following curve of aedeagus; subapical spines elongate, curved; anal segment elongate, longer than genital plates; anal spines short.

Length to apex of tegmina: 6.10–7.40 mm.

Holotype ♂: Isle of Pines; 27 June, 1939; A. R. O. *Allotype* ♀: Isle of Pines; 27 June, 1939; A. R. O.

Planodascalia viridicosta n. sp.

(Pl. II, figs. 4, 5; Pl. IV, figs. 1, 4; Pl. XI, figs. 6, 9)

This species is to be recognized by its somewhat smaller size, lighter colors, with the tegmina nearly uniform mummy brown, with the costal area and sometimes the humeri and claval suture light greenish.

Head broad, nearly as broad as mesonotum; crown short, anterior and posterior margins nearly parallel; frons short and broad, the lateral margins strongly elevated, the median carina fairly evident, nearly percurrent; tegmina elongate, narrow, the costal, apical and claval margins slightly sinuate; apical and sutural angles broadly rounded, apparently strongly produced.

Male genitalia with genital plates short and broad, dorsal tooth very short; anal segment elongate, slender, apical portion strongly decurved; aedeagus slender, curved; apex produced spine-like beyond

apical spines; apical spines elongate, sickle-shaped, slender; preapical spines short, attenuate; subapical spines longer than apical spines.

Head, venter, and legs almost completely light ochraceous orange, the tibiae and tarsi somewhat infuscated; clypeal margin of frons heavily infuscated, this mark sometimes continuing upward along lateral margins to dorsal margin of head; this color sometimes indicated on claval suture and very narrowly on basal subapical line; abdomen ventrad ochraceous tawny, sometimes tinged with green.

Length to apex of tegmina: 6.75 mm.

Holotype ♂: Loma del Gato, Sierra de Cobre, Oriente Prov.; 1–2 Oct., 1935; J. A. and S. C. B. *Allotype* ♀: Santo Thomas, Peninsula de Zapata, Santa Clara Prov.; 5–9 May, 1927; J. A. and S. C. B. *Paratypes:* 1 ♂, Santo Nicolás, Oriente Prov., on *Coffea arabica* Linn.; 20–21 July, 1927; S. C. B. 1 ♀, Camagüey, Camagüey Prov.; 24 Dec., 1921; J. A. 1 ♀, Las Animas, Sierra Rangel Mountains, Pinar del Rio Prov.; 3–5 Sept., 1934; 1500 ft.; S. C. B. and A. R. O. 1 ♀, Las Animas, Sierra Rangel Mountains, Pinar del Rio Prov.; May, 1933; 1500 ft.; S. C. B. and A. R. O.

Planodascalia aguayoi n. sp.

(Pl. XIII, fig. 4)

This is a rather large species of *Planodascalia* with the general color of the body and legs light ochraceous buff. The basal half of tegmina is chiefly ochraceous buff clouded with blackish fuscous on the shoulders and along the costal area. The apical half of tegmina is chiefly blackish fuscous.

The last ventral segment of the female is deeply notched in the median area with a strongly projecting, nearly rectangular tooth in the notch; lateral areas are broadly and somewhat quadrately produced with the posterior margin slightly sinuate and the lateral margins deeply sinuate with the outer posterior angles strongly produced.

Length to apex of tegmina: 7.25 mm.

Holotype ♀: El Yungue Mt., Oriental Prov.; 10 July, 1935; F. Z.

Genus **Flatarissa** nov.

Orthotype *Flatarissa humeralis* n. sp.

This genus resembles *Pseudoflatoides* in having the costal margin of tegmina undulate. Crown of head, however, is much shorter, not as long as its greatest width. In head characters it resembles the genus *Flatoidinus* somewhat, but the crown is composed in large part of the dorsal area of frons.

Crown impressed, separated into two distinct parts; vertex separated laterad from dorsal part of frons by a distinct carina, which fades out on median area; dorsal part of frons produced, distinctly bi-impressed on lateral margins; facial part of frons elongate, lateral margins slightly elevated, slightly arched; dorsal callosity evident; clypeus elongate; pronotum nearly twice as broad as head including compound eyes; central area broadly curved, mesonotum broad and flat, not as broad as pronotum; tegmina elongate, the costal and commisural margins nearly parallel; costal margin evidently undulate; apical margin broadly

curved truncate; costal area nearly two times as broad as costal cell; venation distinct; subcostal vein broadly undulate; a single distinct subapical line; hind tibiae with two spines on apical third.

Flatarissa humeralis n. sp.

(Pl. VI, figs. 10, 11; Pl. XV, figs. 5, 8)

This species is colored somewhat like *Flatoidinus acutus* variety *humeralis* Metc. and Brun.

Crown broader than long, face nearly twice as long as broad; dorsal margin broadly curved; lateral margins slightly widened to antennae and then nearly parallel to clypeus; pronotum twice as broad as median length, triangularly produced on anterior margin; posterior margin broadly incised; mesonotum broader than long.

Male genitalia with pygofer broader than long; genital plates elongate, slender; subapical tooth as long as greatest width of plates; aedeagus slender, somewhat curved; apical spines short, straight, projecting caudad; preapical spines elongate, slender, strongly recurved; subapical spines about one-half as long as preapical spines, slightly curved; anal segment elongate.

General color of head, compound eyes, pronotum and mesonotum and legs pale ochraceous tawny, heavily marked with blackish or blackish fuscous; there is a rather broad band of blackish fuscous across dorsal margin of frons and apical margin of crown; median line of pronotum narrowly fuscous; anterior margin of mesonotum is clouded with blackish fuscous; posterior lateral margins of mesonotum fuscous with two blackish dots at posterior angles of lateral compartments; basal areas of tegmina have a broad fuscous band extending from costal margin across clavus to first claval vein; this fascia is clouded with blackish along some of the veins; costal margin narrowly fuscous; apical margin dotted on veins with blackish fuscous; a cloud of blackish fuscous along sutural margin; before and behind claval suture with numerous irregular fuscous and blackish fuscous spots on tegmina.

Length to apex of tegmina: 11.50 mm.

Holotype ♂: Loma del Gato, Sierra de Cobre, Oriente Prov.; 24–30 Sept., 1935; 2600 ft.; J. A., S. C. B. and L. C. S.

Flatarissa variegata n. sp.

(Pl. I, fig. 4; Pl. VIII, figs. 1, 4; Pl. X, figs. 9, 10)

This species is chiefly olive green above, variegated with fuscous or blackish fuscous; venter, including face and legs, uniform ochraceous buff except blackish spines on hind tibiae and claws.

Head including eyes about half as broad as pronotum; crown including dorsal area of frons about twice as broad as long; frons nearly half again as long as its greatest width; median dorsal callosity evident; frons ecarinate; pronotum nearly four times as broad as its median length, bi-impressed; central area with lateral margins strongly carinate; lateral areas behind compound eyes strongly carinate on anterior margin; mesonotum narrower than pronotum, about as broad as median length, flat, ecarinate; costal area of tegmina broad with numerous narrowly spaced, nearly straight crossveins; subapical line about same

distance from apical margin as greatest width of costal cell; apical area of corium with numerous reticulate cells.

Male genitalia with pygofer short and broad; genital plates deeply incised caudad with a strongly developed tooth on dorsal margin; anal segment elongate, nearly as long as genital plates, much widened caudad, projecting ventrad as a strongly developed plate; aedeagus rather slender with a well-developed dorsal process projecting caudad beyond apex of aedeagus; apex of aedeagus with two pairs of spines, the apical spines straight, projecting cephalad, preapical spines more elongate, curved.

Length to apex of tegmina: 12.70 mm.

Holotype ♂: Pico Turquino, Oriente Prov.; 10–29 June, 1936; J. A.

Genus **Pseudoflatoides** Metcalf

Metcalf 1938a: 401.

Orthotype *Flata tortrix* Guérin Méneville.

This genus may be recognized by the following characteristics: Head including compound eyes narrower than pronotum, usually about half as broad; vertex longer than broad; obtusely triangularly produced on anterior margin; frons elongate, narrow, slightly widened below; lateral margins strongly elevated; dorsal median area produced into a distinct callosity; tegmina broad, horizontal; costal margin broadly undulate; venation distinct; costal area much broader than costal cell; apical area with two irregular subapical lines about equal distance from each other on apical margin; hind tibiae with two stout spines on apical third.

Pseudoflatoides fasciculosus Melichar

(Pl. VIII, figs. 7, 8; Pl. XVI, fig. 5)

Flatoides fasciculosus Melichar 1902a: 205; Pl. 9, fig. 7.

There are two specimens in the present collection which resemble Melichar's short description and illustration of this species. So far as we can determine *griseus* is only a color variety of this species, as the general structure characters and male genitalia seem to agree in essential details. In general coloration this species resembles *tortrix* but it differs in genital structures.

Crown not quite twice as long as width between eyes; face more than three times as long as greatest width, produced into a distinct callosity dorsad; pronotum short and broad, produced cephalad beyond midline of compound eyes; mesonotum not quite three times as long as pronotum; tegmina large; costal margin broadly undulate; subcostal vein prominent, undulate, apical area separated from basal area by a distinct transverse somewhat S-shaped line; reticulations in apical area fine, on basal area coarse.

Male genitalia with pygofer very short; genital plates with a long slender dorsal apical tooth; aedeagus short, stout; apical spines slender, broadly curved, as long as aedeagus; preapical spines slender, shorter than apical; subapical spines very short and broad; anal segment elongate, broad, covering genital plates and aedeagus.

Length to apex of tegmina: 15.00–18.00 mm.

Specimens are at hand from Camaguey, Camagüey Prov.; 15 Aug., 1924, and 26 July, 1923; J. A.

Pseudoflatoides fasciculosus var. **griseus** Melichar

(Pl. VIII, figs. 2, 5)

Flatoides griseus Melichar 1902a: 205.

This was described as a distinct species. We believe, however, that it is a pale variety of *fasciculosus*.

General color pale ochraceous buff with the frontal callosity very black; a large pair of fuscous spots on posterior lateral margins of mesonotum, a few small round black dots in costal area and a few irregular blotches and stripes fuscous or blackish fuscous on corium and clavus.

Length to apex of tegmina: 14.80 mm.

1 ♂, San Vicente, Pinar del Rio Prov.; 6–9 Apr., 1922; J. A. and S. C. B.

Pseudoflatoides fasciculosus var. **fasciatus** n. var.

This is a rather heavily marked variety of *fasciculosus*. The general structure and details of genitalia agree with the typical variety. It differs in the following color markings: There is usually a distinct transverse fascia on anterior margin of mesonotum; lateral margins of mesonotum may be completely black, or this color may break up into two or three pairs of large black spots; there is a distinct transverse blackish or blackish fuscous fascia extending from subcostal vein across corium to apex of clavus; beyond this are usually irregular markings of fuscous and black; costal area has the usual complement of small, round black dots.

Length to apex of tegmina: 14.00–16.00 mm.

Holotype ♂: San Vicente, Pinar del Rio Prov.; 6–9 Apr., 1922; S. C. B. and J. A. *Allotype* ♀: San Vicente, Pinar del Rio Prov.; 6–9 Apr., 1922; S. C. B. and J. A. *Paratypes:* 1 ♂, San Vicente, Pinar del Rio Prov.; 4–6 Sept., 1922; S. C. B. and J. A. 1 ♂ and 3 ♀♀♀, Camagüey, Camagüey Prov., 15 Aug., 1924; J. A. 1 ♀, Sierra Rangel Mts., Pinar del Rio Prov.; 29 Aug., 1927; 1500 ft.; J. A. and S. C. B. 1 ♀, Herradura, Pinar del Rio Prov.; 25 July, 1923; C. H. B. 1 ♀ Santo Tomas, Pinar del Rio Prov.; 19 Apr., 1935; J. A. and S. C. B.

Pseudoflatoides fasciculosus var. **vittatus** n. var.

(Pl. IX, figs. 2, 5)

In general structure and genitalia this species agrees with the typical *fasciculosus*. The color, however, is strikingly different.

General color above and beneath light ochraceous buff sometimes tinged with olive green and heavily marked with brownish fuscous; tegmina heavily covered with a whitish pruinescence, frontal callosity black; posterior lateral margins of mesonotum broadly bordered with black or this border broken up into three pairs of large blackish spots; tegmina with a broad blackish curving vitta extending from the humeral angle to apical angle and the narrow irregular fascia extending from subcostal vein to apex of clavus; on corium beyond apex of clavus an

irregular undulate brownish vitta; a few black dots and lines in costal area.

Length to apex of tegmina: 16.50 mm.

Holotype ♂: Camagüey, Camagüey Prov.; 20 Aug., 1924; J. A. *Allotype* ♀: Guantánamo, Oriente Prov.; S. C. B. *Paratypes:* 1 ♀, Camagüey, Camagüey Prov.; 15 Aug., 1924. 1 ♀, San Blas, Santa Clara Prov.; 15 Oct., 1931; G. C. R.

Pseudoflatoides fasciculosus var. **maculosus** n. var.

(Pl. I, fig. 1; Pl. VIII, figs. 3, 6)

Superficially this variety resembles *Flatoidinus acutus* var. *maculosus* Metc. in that the general color is light ochraceous buff and tegmina are heavily spotted and blotched with fuscous; pronotum with a single median blackish fuscous spot, and mesonotum heavily spotted with blackish fuscous; a single median spot on anterior margin and two pairs of spots on anterior lateral margins; posterior lateral margins with two large spots and a small spot; costal area with numerous large spots of blackish fuscous and corium with four large blotches of fuscous or blackish fuscous and a number of smaller spots; a distinct blackish fuscous stripe on basal margin of clavus, a number of small spots on commisural margin and a larger spot on apex of clavus; beneath including legs light ochraceous buff with lateral margins of abdomen blotched with blackish fuscous; frontal callosity brownish fuscous.

Length to apex of tegmina: 10.90 mm.

Holotype ♀: Santo Tomas, Peninsula de Zapata, Pinar del Rio Prov., on *Solanum* sp.; 5–9 May, 1927; S. C. B. and J. A.

Pseudoflatoides tortrix Guérin-Méneville

(Pl. IX, figs. 3, 6; Pl. XVI, fig. 4)

Guérin Méneville 1856a: 181; 1857a: 431.

There are at least two species in the present collection which would fit Guérin-Méneville's description of this species. We have decided, however, to give this name to one of the most abundant forms, which would fall within Guérin-Méneville's generalized description.

Crown short, broad, usually only about one-fifth longer than greatest width; anterior margin obtusely and triangularly produced.

Male genitalia with pygofer short and broad; genital plates slender, elongate, shorter than anal segment, apical dorsal tooth broad, elongate triangular; aedeagus short and broad with three pairs of spines; apical spines elongate, very slender; preapical spines shorter and broader; subapical spines about as long as preapical spines, slightly curved.

General color pale olive green with the head, thorax, legs, and ventral surface of abdomen tending to fade to olive tawny or tawny; there is a conspicuous black callosity at apex of head, two small round dots on basal third of mesonotum, and many irregular dots and dashes on tegmina. Other specimens are pale honey yellow or pale ochraceous buff in general color.

Length to apex of tegmina: 9.00–10.50 mm.

Pseudoflatoides tortrix var. **flavus** n. var.

This variety is identical in general structure and genitalia with the species *tortrix*. It differs, however, in general color and markings.

General color above ochraceous buff, lightly marked with blackish or brownish fuscous as follows: The lateral areas of pronotum behind compound eyes with two brownish fuscous vittae; mesonotum with a broad central blackish vitta; basal area of clavus, the corium behind the shoulders and costal area with blackish fuscous marks; small round black dots in costal area and apical cells; an indistinct brownish fascia in middle of corium and numerous irregular fuscous markings; beneath almost entirely ochraceous buff except the blackish callosity at apex of frons and spines and claws of the legs.

Holotype ♂: Camagüey, Camagüey Prov.; 20 Aug., 1924; J. A.

Pseudoflatoides tortrix var. **habanensis** n. var.

This variety is identical in general structure and male genitalia with the species *tortrix*. The color, however, is strikingly different.

General color light ochraceous buff, heavily marked with brownish fuscous and black; crown chiefly brownish fuscous with median line and lateral carinae and broad transverse fascia on anterior margin ochraceous buff; pronotum pale ochraceous buff; mesonotum brownish fuscous with intermediate carinae broadly black; tegmina ochraceous buff; costal area and costal cell brownish fuscous with small round black dots and dashes in costal area; apical area of clavus and apical area of corium behind subapical line brownish fuscous; there are two irregular black marks on basal area of corium; transverse fascia near middle of corium; a row of black spots in apical cells; irregular scattered blackish and fuscous dots over entire corium; frons with distinct blackish callosity.

Holotype ♂: Habana, Habana Prov.; 15 Dec., 1941; R. G. C.

Pseudoflatoides tortrix var. **insularis** Melichar

(Pl. VIII, figs. 9, 10)

Flatoides insularis Melichar 1902a: 209; Pl. IX, fig. 10.

If we have correctly identified this form, it is merely a color variety of *Pseudoflatoides tortrix*, as it cannot be distinguished by general structure or genitalia from that species. In general color it resembles *Pseudoflatoides fasciculosus* var. *vittatus* Metc. and Brun. but structurally it belongs to *tortrix*.

General color above and beneath light ochraceous buff; frontal callosity brownish fuscous; a broad black vitta across the lateral margins of pronotum behind compound eyes; mesonotum heavily marked with brownish fuscous; a broad curving vitta across tegmina from humeral angle to apical angle; costal area marked with a few small brown fuscous spots and a few fuscous dashes; apical area of tegmina marked with light fuscous brown; front tibiae and tarsi marked with brownish fuscous.

Length to apex of tegmina: 8.50 mm.

♂: Santiago de las Vegas; C. H. B.

Pseudoflatoides lichenoides n. sp.

(Pl. I, fig. 2; Pl. IX, figs. 1, 4; Pl. XVI, fig. 3)

This is one of the most conspicuously marked species in this genus.

Crown short and broad; pronotum short, the central area triangularly produced; mesonotum small; tegmina broad, conspicuously undulate.

Male genitalia with pygofer short; genital plates elongate, slender, apical dorsal tooth elongate; aedeagus stout; preapical spines elongate, slender; subapical spines broad, acuminate, nearly as long as aedeagus; tenth segment elongate, longer than genital plates.

General color of crown, pronotum, and mesonotum ochraceous tawny; crown with a pair of brownish vittae on lateral margins; pronotum with a distinct blackish fuscous fascia in lateral areas; mesonotum with a blackish fascia near anterior margin; posterior lateral margins marked with a pair of large black marks and behind these are small round black spots; tegmina principally pale ochraceous buff with a broad ochraceous tawny saddle extending from costal margin to sutural margin; in the center of this saddle is a narrow blackish fascia extending from subcostal vein to sutural margin; veins in this area are rugulose and marked with blackish fuscous; the sutural margin heavily marked with blackish; apical area with an irregularly curved fascia extending from subcostal vein around apex of tegmina to apex of clavus and costal margin in undulated areas heavily marked with brownish fuscous; a row of small black spots in apical cells extending from apical angle to sutural angle; beneath chiefly ochraceous buff; frons irrorate with brownish; frontal callosity blackish; front and middle legs with femur and tibiae more or less irrorate with brownish fuscous.

Length to apex of tegmina: 10.20 mm.

Holotype ♂: Pico Turquino, Oriente Prov.; 10–29 June, 1936; 1650 ft.; J. A.

Genus **Flatidula** nov.

Orthotype *Flatidula luella* n. sp.

This genus resembles *Flatoidinus* Mel. in having crown broader than long. Otherwise, however, it differs materially from this genus.

Crown broad, the lateral margins longer than median line, nearly parallel; frons elongate, dorsal margin triangularly incised; head much narrower than pronotum; pronotum broad, the central area broadly produced, extending in front of compound eyes; mesonotum large; tegmina elongate, narrow; costal margin slightly sinuate; costal area broad, reticulately veined; venation of tegmina indistinct; hind tibiae with two spines on apical third, placed close together.

Flatidula luella n. sp.

(Pl. II, fig. 2; Pl. IX, figs. 7, 8, 9)

Crown about four times as broad as its median length; lateral margins nearly twice as long as median length, carinate, nearly straight; anterior margin strongly produced on median third; frons about twice as long as its greatest width, dorsal margin triangularly incised and lateral margins strongly elevated, somewhat broadly curved to level of antennae and then narrowed to clypeus; median carina distinct to level of lower margin of compound eyes; pronotum nearly twice as broad as head including compound eyes; anterior margin obtusely triangularly produced in front of anterior margin of compound eyes; central area strongly depressed; mesonotum large, the anterior central area strongly elevated; venation of tegmina indistinct, the apical half with numerous indistinct irregular, reticulate cells; no subapical line;

costal area nearly four times as broad as costal cell with numerous irregular rather indistinct reticulate veins and crossveins.

General color brownish olive tinged with honey yellow, especially on mesonotum, venter, and legs, strongly marked and spotted with blackish; crown with anterior margin blackish forming two fairly distinct spots on either side of median line; pronotum and mesonotum with a broad blackish median vitta from anterior to posterior margins; pronotum with a few spots in lateral areas; mesonotum with several blackish dots; frons with a pair of blackish dots on dorsal margin and at least two pairs of smaller dots; median carina marked with blackish; rest of frons irregularly marked with blackish; compound eyes brownish, spotted with fuscous; lateral areas heavily marked with black; tegmina with costal area irregularly marked with black; corium with a broad cloud of irregular blackish markings along claval suture and a broad curved fascia from sutural angle to costal angle; clavus clouded with irregular blackish fuscous.

Length to apex of tegmina: 13.00 mm.

Holotype ♀: Camagüey, Camagüey Prov., on *Andira jamaicensis*, 15 July, 1922; J. A.

Flatidula pallescens n. sp.

(Pl. I, fig. 3; Pl. XV, figs. 7, 9)

This is a pale ochraceous greenish species heavily marked with light fuscous.

Crown short and broad, about three times as broad as median length; anterior margin nearly straight; pronotum with central area nearly quadrate, anterior margin broadly curved; posterior margin triangularly incised; mesonotum large with a distinct callosity on median line anteriorly; tegmina long and narrow; costal margin and subcostal vein straight; subapical line irregular; frons nearly one and one-half times as long as broad; dorsal margin deeply triangularly incised; lateral margins strongly elevated; median carina distinct on dorsal half.

Male genitalia with pygofer short; genital plates nearly quadrate, about two and one-half times as long as broad when viewed laterally; preapical dorsal tooth elongate, straight, acuminate; aedeagus elongate, strongly curved; apical spines short and slender; preapical spines about four times as long as apical spines, broadly curved; subapical spines nearly as long as aedeagus, broadly curved; median process slender, acuminate, directed caudad; anal segment relatively slender, apical portion elongate, strongly deflexed.

General color ochraceous tawny with a greenish tinge marked with fuscous as follows: A slender median vitta on pronotum which is continued on mesonotum, widening and bifurcate behind mesonotal callosity; two narrow vittae on preocular area; frons with broad dorsal fascia and a more indefinite ventral fascia; tegmina with several large round fuscous marks in costal area especially along costal margin; numerous irregular blotches on corium, these blotches forming a curved vitta extending from subcostal vein to apical angle; most of apical cells with small round fuscous marks; beneath and legs chiefly pale ochraceous buff.

Length to apex of tegmina: 10.90 mm.

Holotype ♂: San Blas, Trinidad Mts., Las Villas Prov.; 3 May, 1932; S. C. B. and A. R. O.

Genus **Flatarina** nov.

Orthotype *Flatarina aguiari* n. sp.

Crown broader than long, distinctly ecarinate, separated from frons by a broadly curved carina; lateral margins distinctly carinate, broadly curved; frons longer than broad, indistinct median and intermediate carinae on dorsal area; clypeus ecarinate; pronotum short and broad, much broader than head including the compound eyes; lateral margins with a distinct tooth behind compound eyes; mesonotum short and broad; tegmina broad basad, narrowed caudad; costal margin distinctly sinuate toward apex; costal area very broad; venation very irregular; apical margin slightly produced caudad; two irregular subapical lines; hind tibiae with two long spines.

Flatarina aguiari n. sp.

(Pl. VI, fig. 12; Pl. XV, fig. 6)

This ia a pale greenish yellow species with tawny compound eyes; mesonotum pale tawny; base of corium and clavus greenish fuscous, a few irregular dots of fuscous at apex of clavus; costal and apical margins of tegmina fuscous with the sutural margin of tegmina beyond clavus with small fuscous spots in the cells and larger fuscous spots just inside the penultimate subapical line; venter and legs pale ochraceous buff.

Male genitalia with pygofer elongate, broad; genital plates elongate, narrow, not as long as anal segment; subapical tooth triangular and twisted, ventral apical angles produced; aedeagus stout with apical, preapical, and subapical spines elongate, slender, subequal; anal segment elongate.

Length to apex of tegmina: 10.00 mm.

Holotype ♂: Buenos Aires, Trinidad Mts., Santa Clara Prov.; 4 May, 1932; 2350–2800 ft.; S. C. B. and A. R. O.

Named in honor of Mr. Cecilio Aguiar, inspector of the *Seccion de Sanidad Vegetal*, Ministry of Agriculture, Habana.

Genus **Flatoidinus** Melichar

Flatoidinus Melichar 1923a: 117.

Orthotype *Poekilloptera convivus* Stål.

In this genus the crown is broader than long triangularly produced, but the head is narrower than pronotum; pronotum about as long as crown with mesonotum broader than long; frons elongate; tegmina elongate; costal margin about twice as broad as costal cell; two irregular subapical lines, the second short; hind tibiae with two spines.

The species in this genus are very variable in color and there seems to be very little intergradation between the different color varieties. This has led to description of a number of different species which we now consider as mere color varieties. The genitalia seem to be distinctive and are described in some detail.

Flatoidinus obscurus n. sp.

(Pl. XV, figs. 2, 4)

This species is close to *acutus* Uhl. but for the present, at least, we shall keep it separate, based upon slight differences in the male genitalia. There are very few structural characters or color markings that could be used to distinguish this species from *acutus*.

Male genitalia with pygofer more elongate than in *acutus;* genital plates shorter than in *acutus* and with the dorsal tooth more slender and elongate; aedeagus distinctly longer and more slender than in *acutus;* apical spines only about half as long as preapical spines; preapical spines with a distinct tooth on caudal margin near base; subapical spines more slender and elongate than in *acutus;* anal segment much more elongate and slender, lateral processes more elongate and narrower; median process elongate, recurved with a distinct tooth on basal area; apex distinctly widened.

General color above ochraceous brown with crown and pronotum tawny; tegmina more or less clouded along principal veins with fuscous, especially in the area of corium beyond subapical line; general color beneath ochraceous buff with frons ochraceous tawny, clouded with blackish fuscous on dorsal margin; compound eyes blackish fuscous.

Length to apex of tegmina: 8.60 mm.

Holotype ♂: Cayamas, Oriente Prov.; E. A. S.

Flatoidinus acutus Uhler

(Pl. II, fig. 1; Pl. VII, figs. 5, 8; Pl. XV, figs. 1, 3)

Dascalia acuta Uhler 1901a: 514.

This is one of the most widely distributed species of flatids, ranging from Georgia and Florida across the West Indies to Puerto Rico. In Cuba it is widely distributed, ranging from Oriente Province on the west to Habana Province and the Isle of Pines. This is also a very variable species in size and color. The smaller specimens are about eight millimeters in length to the apex of the tegmina, and the larger specimens are nearly fifteen millimeters in total length. In general color the species ranges from pale olive green or light ochraceous buff to deep cinnamon brown. In markings this species varies from almost unspotted specimens with a few small dots in the costal area to forms that are heavily blotched with blackish. This species has no less than four distinct color varieties. We can, however, associate no difference in the genitalia in these four varieties.

Male genitalia with pygofer short and broad; genital plates elongate with a very long dorsal tooth on apical third; aedeagus longer than genital plates; apical spines elongate, slender; preapical spines shorter than apical spines with a triangular tooth on basal third; subapical spines elongate, rather stout; anal segment elongate, the pair of lateral processes not very long, rather broad; median process short, broad, slightly recurved.

We are indebted to Paul W. Oman for dissecting one of the types of *acutus* and sending us a sketch of aedeagus.

Flatoidinus acutus var. **bipunctatus** n. var.

This is a very distinct color variety of *acutus*. The general color is pale ochraceous buff with a pair of large oval blackish spots covering most of the central area of clavus and adjoining area of corium; the costal area has several small black points, and the corium is also spotted irregularly with black between apex of clavus and subapical line; a row of blackish fuscous spots on apical margin; the subapical line is narrowly clouded with fuscous as are the lateral areas of mesonotum.

Length to apex of tegmina: 10.60 mm.

Holotype ♂: Santiago de las Vegas, Habana Prov.; 14 March, 1931; A. R. O. *Allotype* ♀: Santiago de las Vegas, Habana Prov., on *Guánabana;* 8 Aug., 1941; S. C. B. *Paratypes:* 1 ♀, Santiago de las Vegas, Habana Prov.; 17 Aug., 1935; L. C. S. 1 ♀, Habana, Habana Prov., on *Jassimum grandiflora;* 9 March, 1922, C. H. B.

Flatoidinus acutus var. **maculosus** Metcalf

Flatoides maculosus Metcalf 1923a: 191; Pl. 39, fig. 17; Pl. 48, fig. 145.

This is another very distinct color variety of *acutus* with mesonotum usually tawny. The general color above and below is warm ochraceous buff with the tegmina heavily blotched with fuscous over the entire surface.

This species was described from a female from Paradise Keys, Florida, and a male from Marco, Florida. Since that we have received another male from Marco, Florida, and there are two females in the present collection from Cojímar, Habana Prov.; 29 July, 1934; S. C. B.

Flatoidinus acutus var. **humeralis** n. var.

This is a very distinct color variety of *acutus*. Color above and beneath warm buff with a pair of large irregular fascia across the basal areas of the corium and about halfway across the clavus, blackish fuscous; irregular spots and blotches in costal and apical areas of corium with a few irregular larger blotches on corium; two small blotches in lateral areas of mesonotum.

Holotype ♀: Ecano, Habana Prov., on *Casearia hirsuta;* 8 Feb., 1932; L. C. S. *Paratypes:* I ♀, Cuba.

Flatoidinus punctatus Walker

(Pl. XVI, fig. 6)

Elidiptera punctata Walker 1851a: 332.

This species is apparently very close to *Flatoides acutus*. If we have identified it correctly and our identification has been verified by Mr. China from the mutilated type specimen in the British Museum it is a species with a short, obtuse crown, the anterior margin of pronotum broadly rounded, and the genitalia very distinct. This species has been recorded from Cuba. We have, however, no specimens in the present collection. We do have specimens from Florida and Haiti which seem to be typical, and Dr. Oman advises me that the typical series of *acutus* in the National Museum contains specimens which are what we would describe as *punctatus*.

Male genitalia with genital plates and tenth segment about as in *acutus;* aedeagus long and slender; apical spines slender, recurved; preapical spines stout, shorter than apical spines, without marginal tooth; subapical spines elongate, slender, slightly curved.

Flatoidinus dotatus Melichar

(Pl. VII, figs. 6, 9; Pl. XVI, fig. 1)

Flatoides dotatus Melichar 1902a: 222; Pl. 8, fig. 12.

There is a single specimen in our collection which agrees in essential detail with Melichar's description. The crown is not very strongly produced; lateral angles not prominent; pronotum short, rounded on anterior margin, not projecting as in other species. In color our specimen differs decidedly from Melichar's description. Our specimen is almost entirely ochraceous buff, brown above and beneath, but the distribution of the black color markings are similar to the description by Melichar.

Male genitalia are quite similar to *obscurus* and *acutus;* genital plates are broader than in these species with a distinct elongate tooth on dorsal margin; aedeagus somewhat longer than genital plates; apical spines elongate, slender; preapical spines about half as long as apical spines, stouter; subapical spines longer than apical, stouter; apex very acute; anal segment elongate, slender; lateral processes broadly triangular with apex obtuse; no median process.

1 ♂: Isle of Pines; 4–12 Sept., 1928; S. C. B. and L. B.

Flatoidinus olivaceus n. sp.

(Pl. II, fig. 3; Pl. VII, figs. 1, 3; Pl. XVI, fig. 2)

This is a pale olive yellow species with mesonotum tawny and a few small blackish points and fuscous markings on head, pronotum, mesonotum, and tegmina. In general color this species resembles a smaller pale specimen of *acutus.* The genitalia, however, are entirely different.

Male genitalia with genital plates elongate, narrow, dorsal tooth elongate, acuminate; aedeagus straight and stout, shorter than genital plates; apical spines elongate, slender, broadly curved; preapical spines broad, short, about one-third as long as apical; subapical spines elongate, slender, slightly curved, longer than apical, anal segment elongate, narrow, the lateral processes short, obtuse; median process elongate, triangular.

Length to apex of tegmina: 10.50 mm.

Holotype ♂: Nagua, Oriente Prov.; 7 July, 1922; S C. B. and C. H. B. *Allotype* ♀: Santiago de las Vegas, Habana Prov.; S. C. B. *Paratypes:* 1 ♂, Camagüey, Camagüey Prov.; 15 Aug., 1924; J. A. 1 ♀, Santiago de las Vegas, Habana Prov.; 17 Aug., 1935; L. C. S. 1 ♀, Santiago de las Vegas, Habana Prov.; 29 June, 1932; A. R. O.

Flatoidinus pallescens n. sp.

(Pl. VII, figs. 7, 10; Pl. XVI, figs. 7, 8)

This is a light buff colored species averaging somewhat larger than *acutus* and with distinct genitalia. Crown short, somewhat acute;

pronotum broadly rounded on anterior and posterior margins; tegmina elongate, narrow.

Male genitalia with pygofer elongate; lateral margins produced; genital plates elongate, slender, dorsal apical tooth with a distinct basal caudal process; aedeagus elongate, slender; apical spines short, nearly straight; preapical spines strongly recurved; subapical spines short, somewhat recurved; anal segment elongate, narrow, longer than genital plates.

General color light buff; mesonotum ochraceous tawny; dark markings very irregular; there are usually two pairs of blackish dashes on lateral margins of mesonotum and usually several small black punctures in costal area and a row of small points in apical cells.

Length to apex of tegmina: 10.50–11.00 mm.

Holotype ♂: Buenos Aires, Trinidad Mts., Santa Clara Prov.; 4 May, 1932; 2350–2800 ft ; S. C. B. and A. R. O. *Allotype* ♀: Nagua, Oriente Prov., on *lonchocarpus* sp.; 7 July, 1922; S. C. B. and C. H. B. *Paratypes:* 1 ♀, Jarahueca, Oriente Prov., on *Coffea arabica* Linn.; 14–18 July, 1927; S. C. B. 1 ♀, Wajay, Habana Prov , on *Casuarina;* 22 Aug., 1928; S. C. B.

Flatoidinus lugubris n. sp.

This is the largest and darkest colored species of *Flatoidinus* known to us from Cuba.

Crown tawny, the anterior margin blackish; face, legs, and venter ochraceous tawny; dorsal margin of face blackish and two blackish dashes in preocular region; eyes blackish fuscous; pronotum tawny with a greenish tinge; mesonotum dark tawny, anterior margin fuscous and two distinct black spots on posterior lateral margin; anterior two-thirds of tegmina olive green; posterior third blackish fuscous.

Length to apex of tegmina: 12.75 mm.

Holotype ♀: Topes de Collantes, Trinidad Mts., Las Villas Prov.; 10–15 Sept., 1941; A. R. O. *Paratypes*: 1 ♀, Topes de Collantes, Trinidad Mts., Las Villas Prov.; 10–15 Sept , 1941; A. R. O.

NEW NORTH AMERICAN BEES OF THE GENUS DUFOUREA
(Hymenoptera: Halictidae)
PART II

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This is the second of a series of papers describing new *Dufourea.* Subsequent papers will comprise a revision of the North American species which will include illustrations of the bees described in the present series.

As stated in the previous paper, holotypes and allotypes will be deposited in the California Academy of Sciences and paratypes will be placed in the following collections, besides the author's: U. S. National Museum; University of California Citrus Experiment Station, Riverside; American Museum of Natural History, New York. Additional paratypes, when available, will be furnished to other collections upon request.

Dufourea cuprea n sp.

Male.—Length about 7 mm., length of anterior wing 5.2 mm.; pubescence largely pale, considerable dark hair on head; integument very dark with dark blue, bronze reflections; body moderately elongate. *Head:* Face slightly over four-fifths as long as broad; eyes with inner margins nearly parallel, converging slightly at the bottom, their length about five-sevenths the distance between them at antennal insertion; face, viewed directly from in front, with distance between lateral ocelli slightly more than twice that from one to posterior vertex margin; distance from antennal socket to clypeus nearly as great as socket diameter; clypeus short, with long, white, reclining pubescence, basal fringe composed of more erect black hairs, the whole not completely concealing integument; supra-clypeal area with prostrate, sparse, white hair medially, long, erect, black hair on lateral margin; hair between antennal sockets, on frons, scape long, dark grey to blackish; frons coarsely, unevenly punctured, very sparsely so in small areas just anterior to median and laterad to posterior ocellus but more dense along inner eye margins where punctures average about or less than one puncture width apart; area laterad to posterior ocellus slightly depressed; antennae of moderate length, not reaching beyond tegulae; scape over twice as long as broad; flagellum black, slightly clavate, glabrous except for usual, uniform, microscopic pubescence, segments mostly about as long as broad, entirely roughened, second no longer than first or third, first about two-thirds as broad as last; maxilla with stipes shorter than hind tibia, no longer than eye; galea three times as long as broad, two-thirds as long as stipes, pointed apically; maxillary palpus a little over half as long as stipes, first segment nearly half as broad as long, about as long as second, as long as third, fourth, sixth combined; sixth one-third its length longer than third or fourth, three times as

long as fifth which is as broad as long; labial palpus as long as first two maxillary palpal segments together, first segment five times as long as broad, longer than next three together, a little longer than first maxillary, last segment two-thirds the second, three times the third which is as broad as long. *Thorax:* Mesoscutum unevenly punctured, closely, rather finely so anteriorly where punctures average less than one puncture width apart, coarsely, a little more separately on posterior two-thirds and on mesoscutellum where punctures average about or less than one width apart; mesonotal surface rather sparsely covered with long, dark hair and denser but less conspicuous short, white pubescence; wings clear, with decided yellowish tinge, first recurrent vein contiguous with first transverse cubital; posterior wing with six to eight hamuli; legs not conspicuously modified; fore tibia slightly swollen, half as broad as long; mid tibia with no accessory bristles terminally; hind tibia a little over three times as long as broad, densely pubescent on outer side of apical third, with hairs no longer than tibial width; fore metatarsus three, mid four, hind less than three times as long as broad; second to fourth fore tarsal segments broader than long, those of mid, hind legs longer than broad. *Propodeum:* Enclosure rather sparsely covered with very coarse, wavy carinae presenting an irregularly wrinkled appearance; straight line drawn transversely through middle of enclosure cutting fifteen to twenty carinae. *Abdomen:* Tergites finely, sparsely, but distinctly punctured, first with punctures of summit separated on the average by two or more of their diameters, next two with punctures slightly closer basally but similarly sparse apically; punctures tending to be arranged in transverse rows beyond first tergite; impressed apical tergite borders appear dark brown to nearly black; tergal pubescence rather abundant, forming brownish, scarcely distinguishable hair bands laterally; apical tergite with broad, median longitudinal glabrous area; median hair of tergites largely dark; third, forth sternites each with a pair of sub-lateral hooklets which are short, broad, with oblique bases reaching nearly to segment apices; fourth with slight median apical lobe bearing a few scattered, dark hairs; fifth with glabrous, shiny concavity and emarginate apically, except for a median, flat, triangular projection which is approximately equilateral and one-third as long as sternite proper; sixth with strongly depressed, polished, glabrous, median, longitudinal area, half as broad basally as sternite, sharply narrowing apically to merge with median, apical projection which is as thick as broad, four times as long as broad, nearly as long as sternite proper, with a glabrous, concave summit and nearly parallel sides for the basal three-fourths; posterior arms of seventh very broad, flat, the portions not concealed by basal flaps forming nearly equilateral triangles, the inner margins with short bristles or stiff hairs; apical projection of eighth parallel sided on basal two-thirds, narrowed apically to half the basal breadth.

Female.—Length about 7 mm., length of anterior wing 5 mm.; pubescence mostly pale, with some brown facial and abdominal hair; integument black with very dark blue and copperish metallic tints; body robust. *Head:* Face four-fifths as long as broad; eyes diverging below, their length about five-sevenths the distance between them at antennal insertion; face, viewed directly from in front, with distance

between posterior ocelli more than twice as great as from one of them to vertex margin; distance from antennal socket to clypeus about half socket diameter, clypeus evenly, coarsely, sparsely punctured; facial hair mostly sooty brown; frons closely, moderately coarsely punctured, the punctures usually not contiguous but much less than one puncture width apart; antennae black. *Thorax:* Mesonotum moderately coarsely, densely punctured, punctures averaging less than one puncture width apart except at middle, its surface sparsely covered with short, pale brown to white pubescence interspersed with a few long brownish hairs; fore tibial bristles testaceous; tibial scopa moderately dense, pale brownish, slightly recumbent; mid tibial spur twelve times as long as broad, testaceous, becoming darker on apical half; with ten or fewer large, distinct teeth along apical two-thirds, numerous tiny, very fine, indistinct teeth along basal third, the larger teeth contiguous at their bases and little longer than broad. *Propodeum:* Enclosure coarsely, irregularly carinate throughout, the carinae bending outward sharply posteriorly. *Abdomen:* Tergum shining purplish black, with very dark brown apical tergite borders, uniformly, moderately densely but finely punctured, the punctures fairly distinct but usually setigerous, those of middle of first tergite, bases of second and third little more than their diameters apart; tergal pubescence sparse, mostly dark, hardly longer on tergite apices than elsewhere; anal fimbria dark ferruginous; apical tergite with distinct median carina.

Holotype: Wawona, Yosemite National Park, California, May 21, 1938, from *Gilia* (R. M. Bohart). *Allotype:* Same as for holotype. *Paratypes:* 4 females, 7 males, same data as for holotype; 1 male, Indian Flat, Mariposa Co., Calif., from *Gilia* (R. M. Bohart); 7 males, 2 females, Alta, Eldorado Co., Calif., April, 1947 (R. M. Bohart).

Some variation occurs in the regularity of propodeal carination in this species. The carinae are always coarse and irregular but occasionally traceable from anterior to posterior end.

Cuprea is related to *mulleri* (Ckll.), and *nemophile* (Mich.) but may be readily separated by the dark color and simple legs.

Dufourea trochantera n. sp.

Male.—Length about 8 mm., length of anterior wing 5 mm.; pubescence almost entirely pale; integument black with faint bluish and copperish reflections on head; body slightly elongate when abdomen is extended. *Head:* Face slightly broader than long; eyes converging below, their length nearly equal to distance between them at antennal insertion; face as viewed directly from in front with distance between posterior ocelli no greater than from one of them to vertex margin; area between posterior margin of posterior ocellus and upper margin of eye slightly depressed; distance from antennal socket to clypeus slightly greater than socket diameter; clypeus with abundant, semi-erect hair, short on apical margin, becoming longer toward base, remainder white except for basal fringe of dark hairs which do not conceal integument; supra-clypeal area with dense, reclining, white pubescence; inner eye margins at region of antennal insertion with long, erect, greyish hair; outer eye margins with a few long dark hairs extending around to form sparse, shorter pubescence on frons at the middle, the cheeks and frons

otherwise with white hair; frons dull, coarsely, closely punctured, the punctures nearly contiguous anterior to median ocellus, more separate posteriorly with inter-punctural areas usually roughened; antennae of moderate length, reaching beyond tegulae, with flagellum not at all clavate, dark brown in color, the segments as viewed from above, except second and last, about as broad as long, the second only slightly longer than first, the first five each with from three to five yellowish brown hairs which are as long as flagellar width and have their apical thirds strongly bent towards flagellar apex; scape swollen, more than half as broad as long, with long black hair on inner side, short, dense, white hair on outer and under sides; maxilla with stipes considerably shorter than posterior tibia, slightly shorter than eye; galea slightly less than three times as long as broad, half as long as stipes, sharply pointed apically; maxillary palpus about three-fourths as long as stipes, extending less than three segments beyond galea, the first segment not more than three times as long as broad, slightly shorter than second, both together about as long as next four together of which the middle two are each two-thirds as long as either third or last segment; labial palpus about as long as galea; first segment six or more times as long as broad, distinctly longer than second which is twice the last which is twice the third. *Thorax:* Mesoscutum rather coarsely, unevenly punctured, the anterior part densely, the median part sparsely with punctures separated usually by two or more of their diameters; mesoscutellum uniformly, rather densely punctured; surface of mesonotum with sparse, short white pubescence and a few long dark hairs; wings clear with a yellowish stain, the second transverse cubital vein separated from second recurrent by half its own length; legs rather conspicuously swollen, otherwise modified; fore trochanter produced inwardly into a spine-like process longer than broad; fore femur almost two-thirds as broad as long; fore metatarsus with basal width of the stridulus nearly twice that of segment apex; third, fourth fore tarsal segments produced inwardly, twice as broad as long; mid legs nearly normal, the metatarsus about four times as long as broad, the third, fourth segments nearly twice as broad as long; hind trochanter with under side strongly produced into a sharply carinate ridge, causing the segment to be over twice as broad as long; hind femur quite swollen, two thirds as broad as long; hind tibia arcuate, one-third as broad as long, pubescence of outer side short, sparse, fine, that of inner side forming a ridge of long white hairs, longer than tibial width; hind metatarsus polished, expanded, two-thirds as broad as long, second segment about twice as broad as long, third, fourth slightly broader than long. *Propodeum:* Enclosure coarsely, rather evenly carinate throughout, the carinae strongly diverging posteriorly. *Abdomen:* Tergites distinctly punctured, the punctures mostly not setigerous, separated by little more than one of their diameters on densest areas, a little more separate on summit of first tergite; posterior tergite borders testaceous; hair bands long, white, especially fourth, fifth; apical tergite with longitudinal, median, roughened, glabrous area; third, fourth sternites each with a pair of sublateral tubercles one-third the way from apex to base; fourth polished, impunctate, glabrous on concave ventral surface, terminating in a sharply pointed, flat, sparsely pubescent, median apical projection which

is longer than broad, over half as long as sternite proper at mid line; sixth with strongly depressed, median, longitudinal, glabrous, impunctate area, nearly as broad as long on sternite proper but extending apically as the median concavity of an apical spine-like process which is three times as long as broad, sharply pointed, laterally carinate; posterior arms of seventh as broad basally as their underlying basal flaps and each forming, where not hidden by the flaps, an isosceles triangle, the longest side being the lateral margin of the arm whose inner margin is beset with short bristles becoming long hairs apically; apical projection of eighth broad basally, tapering posteriorly to form a laterally compressed digit no broader than the carina of the base.

Female.—Length about 8 mm., length of anterior wing 5 mm.; pubescence almost wholly pale; integument black with distinct bluish tint on face, very faint purplish copper tint on mesoscutum. *Head:* Face about seven-eighths as long as broad; inner margins of eyes approximately parallel, eye length about six-sevenths the distance between them at level of antennal insertion; as viewed directly from in front, distance from posterior ocelli to margin of vertex a little over half as great as distance between them; clypeus evenly, coarsely, and sparsely punctate with sparse white pubescence and basal fringe of brownish hairs; frons bare except for long, sparse, brown hairs, closely and rather coarsely punctured, the punctures nearly contiguous. *Thorax:* Posterior elevated portion of pronotum short laterally, nearly absent medially; mesoscutum rather densely covered with very short pubescence which nealy obscures integument as viewed from the side and is interspersed with a few long brownish hairs; tibial scopa dense, recumbent, white, slightly brownish on top; mid tibial spur about ten times as long as broad, slightly arcuate, smoothly tapering to a point apically, with about nine teeth, the apical six separated by more than their lengths, apical one equidistant from nearest tooth and spur's apex. *Propodeum:* Enclosure coarsely and irregularly carinate throughout. *Abdomen:* First three tergites distinctly punctured, first one medially, next two basally with punctures separated by little or no more than one puncture width; all tergites except first and last with distinct, complete, white hair bands; abdominal pubescence brownish except in hair bands and anal fimbria where it is ferruginous with an orange tinge; apical tergite with median longitudinal carina. *Holotype* and *allotype:* Mammoth Lakes, Mono Co., California, elevation 9000 ft., July 22, 1936, (G. E., R. M. Bohart). *Paratypes:* 1 male, 1 female, same place as holotype, July 26, 1933, (R. M., G. E. Bohart); 2 males, Big Flat, Coffee Creek, Trinity Co., Calif., June 20, 1934, (G. E. Bohart); 1 male, Weott, Humboldt Co., Calif., June 3, 1936, (E. C. Van Dyke); 1 male, 1 female, Goldlake, Sierra Co., Calif., July 14, 1921, (C. L. Fox); 2 males, 4 females, Lake Tahoe, Eldorado Co., Calif., June 19, 1936, (R. M. Bohart); 1 male, Yosemite Valley, Marispoa Co., Calif., July 8, 1921, (E. C. Van Dyke); 1 male, Mill Valley, Marin Co., Calif., May 2, 1936, (C. L. Fox); 1 female, El Portal, Mariposa Co., Calif., May 18, 1938 (R. M. Bohart); 1 male, 2 females, Giant Forest, Tulare Co., Calif., July 21, 1923, (C. L. Fox); 1 female, Mono Lake, Mono Co., Calif., (G. E. Bohart); 15 males, Mineral King, Tulare Co., Calif., on *Phacelia*, (R. M. Bohart); 4 females, 1 male, McKenzie Ridge, Lane Co., Oregon,

July 20, 1909, (J. C. Bridwell); 1 male, Timberline Lodge, Mt. Hood, Oregon, July 23, 1937, (E. C. Van Dyke); 11 males, 8 females, Jenny Lake, Grand Teton Nat. Park, Wyoming, June, 1941, on *Phacelia*, (G. E. Bohart); 4 males, 6 females, Logan, Utah, June 12, 1947, on *Phacelia*, (G. E. Bohart); Three females collected by the author on Bogacheil Mtn., Mt. Olympus Nat. Park, Wash., August 4, 1938, on *Phacelia* are apparently *trochantera* but are a little darker than usual in color.

The series from which this species was determined shows slight variations in number of antennal hairs, in length of the process of the fifth sternite, and in degree of metallic color on the face. The females vary somewhat in size and as to amount of abdominal pubescence and completeness of hair bands.

This is related to *mulleri* (Ckll.) from which it can be separated by the produced trochanter of the male. No constant character with which to distinguish the females was discovered.

Dufourea vandykei n. sp.

Male.—Length about 9 mm., length of anterior wing 5.2 mm.; pubescence wholly pale; integument black, without tinge of blue, green, or copper; body elongate. *Head:* Face a little less than five-sixths as long as broad; eyes very slightly diverging below, their length about three-fourths the distance between them at antennal insertion; face, viewed directly from in front, with distance from lateral ocelli to vertex margin about two-thirds the distance between them; distance from antennal socket to clypeus nearly two-thirds socket diameter; clypeus concealed by dense, white, reclining hair tuft, extending beyond clypeus for distance equal to clypeal length; supra-clypeal area also concealed, its lateral margins with hair becoming long, grey, more erect; punctures of frons rather coarse, dense, separated by less than one puncture width except along inner eye margins, and near ocelli; antenna of moderate length, not reaching beyond tegula; scape swollen, three-fifths as broad as long; flagellar segments, seen from above, slightly longer than broad, the second somewhat longer than first or third, two-thirds as broad as long, the first four entirely black, roughened; entire flagellum with a single row of thick, white, sensory hairs, bent at right angles near their middles, a little shorter than flagellar width, usually two in number per segment, six on first, four on second, third; maxilla with stipes shorter than hind tibia, no longer than eye; galea three times as long as broad, pointed apically; maxillary palpus three-fourths as long as stipes, first segment three times as long as broad, as long as second, one-third its length longer than last, nearly twice as long as any of others; labial palpus only half as long as mentum, first segment about seven times as long as broad, distinctly longer than second maxillary, as long as next three labial together which are sub-equal. *Thorax:* Mesoscutum rather dull, moderately coarsely, closely punctured, punctures averaging a little more than one puncture width apart, surface moderately densely clothed with long, white hair; wings clear with slight yellowish tinge, first transverse cubital vein offset from first recurrent by half its own length; posterior wing with eight hamuli; legs not conspicuously modified; fore femur swollen along its outer side, half as broad as long, nearly

as thick as broad, with but few scattered hairs; mid tibia with short, rather close hair; hind tibia slightly broadened subapically, two-sevenths as broad as long, with pubescence shorter than tibial breadth; metatarsi each about four times as long as broad; succeeding segments as long as or longer than broad. *Propodeum:* Enclosure shining, sparsely, rather coarsely, evenly carinate, the carinae not attaining posterior margin of enclosure, about twenty in number. *Abdomen:* Tergites coarsely, closely punctured, summit of first, apical thirds of others with punctures somewhat more than one puncture width apart, tergite bases more closely punctate; impressed apical tergite borders clear, nearly colorless; tergal pubescence scanty, forming weak hair bands laterally, pale at centers of tergites; apical tergite with narrow, longitudinal, median, glabrous line; depressed areas of sternites strongly defined; second with sub-lateral, sub-apical swellings; third, fourth each with a pair of sublateral, apical hooklets and a dense apical pubescent band; fifth transversely swollen along the apical margin which is evenly emarginate; sixth with a broad, raised, median longitudinal, testaceous, minutely pubescent area, as broad as long, with lateral margins converging strongly towards a flame-shaped apical projection, which is nearly concealed by a long, dense, white hair tuft; posterior arms of seventh very broad, flat, rounded apically, with apical yellow hair tufts half as long as arms; terminal projection of eighth basally broadened, narrowest at middle, becoming imperceptibly broader at apex where it is one-fourth as broad as base.

Female.—Length about 8 mm., length of anterior wing 5.1 mm.; pubescence wholly pale; integument black as in male; body robust. *Head:* Face four-fifths as long as broad; eyes approximately parallel, very slightly divergent below, their length three-fourths as great as the distance between them at antennal insertion; face, viewed directly from in front, with distance between posterior ocelli over twice that from one to vertex margin; distance from antennal socket to clypeus about half socket diameter, distance between sockets over twice as great as their diameters; clypeus short, covered with white pubescence, with about twenty large, scattered punctures; hairs of frons almost all white, surface coarsely, moderately densely punctured, but separated by at least one of their diameters along inner eye margins and a broad band in front of ocellar triangle; antennal flagellum dull brown above on apical six segments. *Thorax:* Posterior lateral angle of pronotum with dense white hair pad; mesoscutum moderately finely, rather sparsely punctured, punctures of densest areas along anterior margin separated by about one puncture width, of remainder by two or three; mesonotum sparsely covered with short, fine hairs interspersed with fewer long, pale ones; terminal bristles of fore, mid tibiae testaceous; mid tibial spur testaceous, straight, evenly tapered to a point, with about nine fairly prominent teeth on apical half, numerous very fine ones on basal half; tibial scopa rather sparse, pale with greyish hairs on dorsal margin. *Propodeum:* Enclosure shining, posterior third smooth, remainder with about twenty coarse, straight carinae with clearly visible interspaces. *Abdomen:* Tergites well punctured, summit of first, basal halves of others with punctures separated by about or little more than one puncture width; impressed, apical tergite borders pale testaceous;

pubescence of first four tergites short, scanty, forming sparse hair bands laterally, covering rather denser ones under tergite borders; median hair of fifth tergite brown; anal fimbria testaceous.

Holotype, allotype, 20 male *paratypes:* Westgard Pass, Inyo Co., Calif., June 3, 1937, from *Sphaeralcea ambigua* (J. W. Johnson, N. W. Frazier, E. C. Van Dyke, C. D. Michener). Other *paratypes* include: 2 males, 3 females, near Kearsarge, Inyo Co., Calif., May 25, 1937 (E. C. Van Dyke); 2 males, Lone Pine, Inyo Co., Calif., and one male, Keeler, Inyo Co., May 22, 1937 (E. Gehrhardt); 2 males, Mazourka Canyon, Inyo Co., Calif., elevation 6000 feet, on *Sphaeralcea ambigua,* May 23, 1937; 1 male, Chocolate Mountains, Riverside Co., Calif., April 4, 1937 (E. G. Linsley); 1 male, Yermo, Calif., April 4, 1940 (Evernham).

The specimens in this series vary somewhat as to density of punctation and as to hair color which tends to become yellowish on some.

This species has no close relatives. Probable affinities can be traced to the *echinocacti* Timb. group. It differs strongly, however, in the possession of sternal hooklets, lack of leg modifications, and a broad head.

Dufourea pectinipes n. sp.

Male.—Length about 6 mm., length of anterior wing 4 mm.; pubescence white except for some brown clypeal hair; integument dark with bluish, greenish reflections; body elongate. *Head:* Face distinctly longer than broad; eyes converging slightly below, distance between them at antennal insertion a little greater than their length; face, viewed directly from in front, with distance between lateral ocelli about twice that from one to posterior vertex margin; distance from antennal socket to clypeus nearly as great as socket diameter; clypeus nearly half as long as broad, with mixed brown, white sparse hairs, not concealing integument; frons well rounded, rather strongly bluish, non-reticulate, mostly with punctures much less than one puncture width apart; antenna long, reaching beyond tegula, flagellar segments smoky dark brown to black, without distinct rows of sensory hairs, the second segment somewhat longer than first, a little shorter than third, the first three wholly roughened, elevated above on apical halves; scape a little more than twice as long as broad; maxilla with stipes slightly longer than hind tibia; galea nearly as long as stipes, over five times as long as broad; maxillary palpus as long as stipes, not quite attaining tip of labial, first segment four times as long as broad, subequal to fourth, slightly longer than fifth or sixth, three-fourths second or third which are half as long as second labial; labial palpus longer than mentum, first segment eight times as long as broad, equal to second, twice the third, nearly four times the fourth. *Thorax:* Mesoscutum coarsely, moderately closely punctate, punctures on average separated by distinctly less than one puncture width, no closer laterally except on anterior margin; area between punctures shining, non-reticulate; surface of mesonotum with short, sparse, pale pubescence; wings clear but somewhat yellowish, with dark veins, the first transverse cubital vein contiguous with first recurrent; posterior wing with five to six hamuli; legs somewhat deformed, modified; fore tibia slightly swollen, with broad, prominent terminal

hooklet directed at right angles to tibial axis; mid tibia swollen, its greatest breadth somewhat beyond middle where it is half as broad as long, its apex with two concealed, short, dorsal bristles, a long curved median hooklet, a ventral clump of five or more stout, yellowish bristles; hind tibia nearly four times as long as broad, outer surface shining, very sparsely haired; fore, hind metatarsi four times as long as broad, mid one three times; second to fourth fore tarsal segments broader than long. *Propodeum:* Enclosure closely, slightly irregularly carinate, becoming smooth on apical lateral corner; imaginary line drawn transversely through center cutting about thirty carinae. *Abdomen:* First three tergites rather strongly punctured, punctures separated by little less than one of their diameters on summit of first, anterior halves of second, third; abdominal pubescence brown, very short, sparse, not forming distinct hair bands; apical impressed tergite borders testaceous to clear; third sternite with low, lateral swelling but no distinct hooklet; fourth with sub-apical, sub-lateral hooklet and with apical margin evenly convex between lateral emarginations; fifth with low, unthickened, median swelling on apical half; sixth with broad, median, longitudinal, glabrous, convex, pale band, defined laterally by groove, the band extending apically to form a broadly flame-shaped, pointed projection, about equal in length to band of sternite proper, the projection not crowned with dense hair tuft except at apex, the lateral margins with long hairs; seventh with posterior arms as broad basally as their basal ventral flaps, tapering evenly from bases to narrow, apical, diagonal truncations, the apical portions slightly thickened, with long apical hairs becoming short along lateral margins; apical projections of eighth basally broadened, narrowest at middle, expanding almost imperceptibly towards apex which is one-third basal breadth.

Female.—Length about 5 mm.; length of anterior wing 3.7 mm.; pubescence brownish to whitish; integument dark with dark blue metallic reflections (some violet on abdomen); body robust. *Head:* Face slightly longer than broad; inner eye margins parallel; eye length as great as distance between them; face viewed from front with post-ocellar distance less than ocellar diameter; area laterad, posterior to posterior ocellus well rounded; distance from antennal socket to clypeus about equal to socket diameter; clypeus one-half as long as hind metatarsus, with semi-erect brown hair; frons closely, coarsely punctured, the punctures much closer than one puncture width apart, even close to ocelli; flagellum dull yellowish brown above on last eight segments; galea beyond maxillary palpus as long as hind tibia, maxillary palpus somewhat longer. *Thorax:* Dorsal surface closely, coarsely punctured as the frons; pubescence rather short, erect, gray to brownish; fore and mid tibiae each with an outer apical fringe of curved testaceous spines; hind wing with six hamuli. *Propodeum:* Enclosure closely, coarsely, somewhat irregularly carinate, a straight line drawn transversely across the middle cutting about twenty-five carinae. *Abdomen:* Tergites uniformly, rather strongly punctured, the first with punctures of disk averaging from one to two puncture widths apart; apical tergite borders pale testaceous, not at all hidden by sparse, testaceous hair fringes; anal fimbria testaceous.

Holotype and 2 male *paratypes:* Tuolumne Co., California, elevation

3500 feet, June 9, 1938, from *Mimulus layneae,* (R. M. Bohart). *Allotype:* Oakhurst, Madera Co., California, May 19, 1942, from *Mimulus.* Two male *paratypes:* Shingletown, Shasta Co., Calif., June 2, 1941, from *Mimulus,* (C. D. Michener).

One of the paratypes and the allotype have a distinct offset between the first transverse cubital and first recurrent veins. The males are otherwise quite similar.

The male of this species resembles *D. versatilis* Bridwell in many details and must be related in spite of the fact that *versatilis* was described as a separate genus (*Mimulapis*) and has generally been separated by later authors. The female resembles *versatilis* somewhat (particularly in the mouthparts) but also seems to be related to *D bernardina* (Michener), from which it can be distinguished at once on the basis of its long galea, glossa, and palpi.

Dufourea longiceps n. sp.

Male.—Length about 7 mm., length of anterior wing 4.9 mm.; pubescence almost entirely white; integument black without tinge of blue, green, or copper; body elongate. *Head:* Face five sixths as broad as long; eyes converging slightly below, distance between them at antennal insertion a little less than eye length; face, as viewed directly from in front, with space between posterior ocelli about twice that from one to posterior vertex margin; distance from antennal socket to clypeus distinctly greater than socket diameter; face of clypeus markedly convex, crowned with long, white, reclining pubescence, continuing on supraclypeal area, bounded laterally by fringe of long, dark, brown hair; frons above antennal scapes with long sparse hair, its surface non-reticulate, coarsely, moderately densely punctured, punctures separated on average by more than one puncture width along inner eye margins and laterad to posterior ocelli, about or somewhat closer than one width otherwise; antenna long, reaching beyond mesoscutum, flagellum almost imperceptibly clavate, first segment four-fifths as broad as last, slightly longer than broad, three-fourths as long as second which is no longer than succeeding segments which are each two-thirds as broad as long seen from above; flagellum yellow above and on outer side beyond middle of first segment, the segments glabrous except for usual uniform microscopic pubescence, with rough areas on upper surface beyond second segment confined to small, raised, apical rings; scape nearly three times as long as broad with mostly long, white hairs, few short dark ones; maxilla with stipes slightly longer than hind tibia, one-third its length longer than eye; galea three times as long as broad, less than half as long as stipes, narrowly rounded apically; maxillary palpus nine tenths as long as stipes, first segment four times as long as broad, two thirds as long as second, little longer than any of remaining segments which are subequal; labial palpus about three fourths as long as stipes, first segment nearly ten times as long as broad, as long as next three combined, the last two subequal, each two thirds as long as second. *Thorax:* Mesoscutum coarsely, rather uniformly punctate, punctures mostly about one width apart; punctures of mesoscutellum a little more separate; mesonotum covered with moderately long, sparse white pubescence, some shorter hair, especially laterally; wings clear hyaline,

practically without greyish or yellowish tinge, veins, stigma nearly black, first transverse cubital vein separated from first recurrent by its own length; legs not conspicuously modified; mid tibia with two stout, testaceous bristles on apical fourth of posterior margin in addition to normal tibial bristle; fore metatarsus beyond stridulus, mid metatarsus at least four times as long as broad, succeeding segments longer than broad; hind tibia over four times as long as broad, densely covered, especially apically, with white pubescence no longer than tibial width; hind metatarsus broadened, about half as broad as long, succeeding segment produced posteriorly, as broad as long, remaining segments longer than broad. *Propodeum:* Enclosure strongly, closely, somewhat irregularly carinate, straight transverse line drawn through middle cutting about twenty-five carinae, the vertical posterior portion thrown into transverse carinae. *Abdomen:* Tergites with uniformly spaced, coarse punctures, those of first four averaging a little more than one puncture width apart; apical impressed margins of tergites apically clear on first three, mostly dark on others; tergal pubescence scattered, sparse, forming distinct hair bands only laterally, that of middles of third to fifth; tergites dark; third and fourth sternites each with a pair of sub-lateral, small, blunt, scarcely curved hooklets, distant from apical margin, second to fifth approximately truncate apically; sixth with a median, longitudinal, raised, impunctate, glabrous area on basal third, its sides converging posteriorly, its surface elevating on posterior half of segment to form a glabrous, thorn-like ridge, dropping abruptly from its apex posteriorly just before sternite apex which bears a minute raised point; posterior arms of seventh broad basally, less than twice as long as their basal ventral flaps, their apices sharply pointed, with short hairs, their inner margins straight; apical projection of eighth with long, lateral hair fringe, narrowest part one third the distance from apex where it is half as broad as at apex or base.

Female.—Length about 7 mm., length of anterior wing 5 mm.; pubescence largely pale; integument black as in male; body rather robust. *Head:* Face longer than broad by distance behind ocelli; inner eye margins approximately parallel, distance between them at antennal insertion a little greater than eye length; median ocellus distinctly posterior to eye; face, as viewed directly from in front, with distance between lateral ocelli about twice that from one of them to posterior margin of vertex; clypeus produced, strongly convex, with a few scattered punctures of large and small size, with basal fringe of black hairs which continue along sides of supra-clypeal area, inner eye margins, surface of frons; middle of supra-clypeal area, antennal scapes, interscapal area with mostly pale hair; frons rather coarsely punctured, the punctures sparse along inner eye margins, about one puncture width apart over rest of frons, except latero-posteriorly where they are more close, coarse; antennal flagellum dull yellowish brown above on apical three fourths. *Thorax:* Elevated posterior portion of pronotum distinct laterally but almost obsolete medially; mesoscutum coarsely, uniformly punctate, the punctures mostly separated by about one of their diameters; mesoscutellar punctures more separate medially; mesonotum sparsely covered with mostly dark brown to black, short and moderately long hairs; apical bristles of fore, mid tibiae testaceous, frequently with

black tips; mid tibial spur testaceous, straight, about fifteen times as long as broad, the basal half without distinct teeth, the apical half with only about five teeth which are reclining, rather fine; tibial scopa rather dense, arising from tibia at more than a fifty degree angle, white except for coarser, shorter, darker hairs at base and along upper margin. *Propodeum:* Enclosure completely, rather coarsely, closely, evenly carinate, the median carinae tending to converge posteriorly, the posterior margin with several transverse carinae; a straight line drawn through middle of enclosure cutting about twenty carinae. *Abdomen:* Tergites rather coarsely punctured, punctures of first, apical halves of next two mostly two of their diameters apart, those of basal fourth of second, third closer but finer; tergal pubescence very sparse, hair bands generally confined to lateral margins or to bases of tergites; pubescence at middle of tergites mostly short, dark; anal fimbria dark sooty brown.

Holotype.—Wildrose Canyon, Panamint Mts., Inyo Co., Calif., May 27, 1937, from *Phacelia*, (C. D. Michener). *Allotype* and one *paratype* female: Same as for holotype.

This can be placed with the same group as *novae-angliae* (Robt.) and *monardae* (Vier.) but is not very close to either of them: It is easily separated by its mostly pale pubescence, yellow antennae, colorless wings, and absence of lateral swellings on the sixth sternite of the male.

Dufourea afasciata n. sp.

Male.—Length about 12 mm., length of anterior wing 8 mm.; pubescence mostly pale on head, thorax, mostly black on abdomen; integument jet black with no tinge of blue, green, or copper. *Head:* Face distinctly longer than broad; eyes converging slightly below, distance between them at antennal insertion slightly less than eye length; face, viewed directly from in front, with distance between posterior ocelli no greater than from one of them to posterior vertex margin; frons between eyes and between posterior ocellus and upper eye margin depressed; distance from antennal socket to clypeus greater than socket diameter; clypeus with abundant, long, semi-depressed, yellowish white hair not entirely concealing integument; supra-clypeal area strongly convex, carinate medially; frons between eye, scape with abundant long, fine, pale hairs; frons moderately finely, unevenly punctate, the punctures very fine, close just anterior to impunctate area in front of ocelli, coarser, separated by a puncture width along inner margins of eyes, very sparse just posterior and laterad to lateral ocellus; interpunctural areas mostly reticulate, otherwise roughened; antenna very long, reaching beyond base of abdomen, the flagellar segments yellow above and on outer side, swollen sub-apically, glabrous except for usual uniform, microscopic pubescence, over twice as long as broad, the last shorter than any except first, the second three times as long as broad, unswollen, the first black, only slightly longer than broad as seen from above; maxilla with stipes distinctly longer than hind tibia or eye; galea over four times as long as broad, over half as long as stipes, rounded apically; maxillary palpus longer than stipes, the first segment nearly half as broad as long, about two-thirds as long as second which is slightly longer than third, one-fourth its length longer than fourth or

fifth, about as long as sixth; labial palpus with segment one about six times as long as broad, one-fourth its length longer than second or third, twice as long as fourth, as long as second maxillary palpal segment. *Thorax:* Mesonotum rather dull, moderately closely, coarsely punctured, the punctures, except at middle, mostly somewhat less than one puncture width apart, surface densely clothed with greyish white, mostly long hairs which partially conceal the integument even from dorsal view; mesepisternum densely clothed with long pale hairs; wings clear, with rather strong tinge of smoky yellow; first transverse cubital vein offset from first recurrent by less than half its own length; posterior wing with about fourteen hamuli; legs greatly swollen and modified; coxae, trochanters normal; fore femur slightly swollen sub-basally on inner side; mid femur with inner side tremendously enlarged, causing the segment to be shaped like a semicircular glabrous plate; hind femur swollen, strongly concave beneath, inner margin of the concavity forming a high, sharply carinate ridge which is produced backward toward the coxa as a long, flat, spine-like process; fore tibia greatly swollen, two-thirds as broad as long, its posterior margin with a deep, sub-apical, semi-circular notch cradling proximal end of tibial spur which is produced proximally, distally; mid tibia with a strong hump near the middle of its outer ventral side, the hump as broad as long, bounded distally by a large, semi-circular notch close to tibial apex which overhangs metatarsus; mid tibial spur four times as long as broad; hind tibia two-thirds as broad as long, its dorsal margin sharply carinate, its ventral outer side near base with a compact row of long, dense black hairs which extend distally onto base of a long, curved, spinular process, bounded distally by a compact row of long white hairs; fore metatarsus nearly half as broad as long; mid metatarsus one-third as broad as long, its outer side polished, glabrous, its margins curved, twisted; hind metatarsus greatly expanded, about three times as long as fore one, nearly half as broad as long, its outer side concave, obscured by fine, exceedingly dense, pale hair becoming coarse, black on dorsal margin; second to fourth fore tarsal segments considerably broader than long. *Propodeum:* Horizontal portion of enclosure twice as long as metanotum, strongly but evenly carinate, the carinae mostly separating anteriorly, their number on the median half more than forty. *Abdomen:* Tergites entirely black, pubescence coarse, black, not forming hair bands; on tergites four to six, mostly pale, but fine on one to three; tergal punctures entirely setigerous, uniformly, rather densely covering surface, except for posterior borders; fourth sternite depressed medially, densely hairy laterally, with a broad, flat, truncate lobe at apex bearing a short terminal hair fringe; fifth reduced to a transverse band with a strong, median transverse fold, the sub-lateral apical margin with a pair of hooklets modified into broad, flat, tooth-like structures; sixth with a broad, median, slightly elevated, shining area, extending apically to form a transverse roughened ridge which is bounded apically by the flat, depressed, broad base of an apically thickened, raised sternal projection twice as long as its greatest breadth; posterior arms of seventh obsolete, replaced by their greatly enlarged, thickened, ventral basal flaps, apical projection of eighth about five times as long as broad, medially carinate, broader sub-apically than apically, with lateral

margins densely haired, those of sub-apex bearing long, backward curled, golden pile.

Female.—Length about 11 mm., length of anterior wing 7.5 mm.; pubescence black except for dorsum of thorax; integument jet black; body moderately robust. *Head:* Face slightly longer than broad; inner eye margins nearly parallel, distance between them at antennal insertion about as great as eye length; face, viewed directly from in front with distance between posterior ocelli a little greater than from one to posterior vertex margin; distance from antennal socket to clypeus equal to socket diameter; clypeus rather long, truncate apically, with a few large scattered punctures; supra-clypeal area with a strong, median longitudinal ridge, very finely punctured; frons unevenly, rather finely punctate, very closely, nearly contiguously punctate medially but coarsely, sparsely so along inner eye margins; antennal flagellum black. *Thorax:* Elevated posterior portion of pronotum nearly as prominent medially as laterally; mesoscutum dull, closely, rather coarsely punctate anteriorly, more sparsely medially and posteriorly, punctures mostly about one puncture width apart, the inter-punctural areas distinctly reticulate; mesoscutellum sparsely punctate, the punctures mostly two or more of their diameters apart; mesonotum with surface densely covered by long, greyish white pubescence nearly concealing integument; terminal hooklets of fore, mid tibiae black, stout; mid tibial spur ferruginous, straight, a little more than six times as long as broad, with over twenty teeth on apical three-fourths; tibial scopa coarse, jet black, dense, concealing integument. *Propodeum:* Horizontal portion of enclosure twice as long as metanotum, strongly but evenly, rather closely carinate, a straight line drawn transversely from center of enclosure cutting at least twenty carinae. *Abdomen:* Tergum finely reticulate, entirely jet black, punctures obsolete or minute, setigerous; pubescence of last four tergites coarse, black, of first two somewhat finer, partially pale; white hair bands confined to bases of segments, scarcely visible even with abdomen extended; anal fimbria black; apical tergite with strong median carina.

Holotype: Shasta Springs, Shasta Co., Calif., June 16, 1920, (C. L. Fox); *Allotype:* Prospect, Oregon, June 20, 1924, (C. L. Fox); *Paratypes:* 3 males, 3 females, Trinity Co., Calif., May 16 to 18, 1934, from *Trifolium*, (G. E. Bohart); 3 males and 1 female, same data (E. C. Van Dyke); 1 male, Hanson's Resort, Jefferson Co., Oregon, July 29, 1929, (E. C. Van Dyke).

Despite the grotesque characters of this species, available specimens show no significant variation.

This belongs with *D. spinifera* (Viereck) in an aberrant group called *Cryptohalictoides* by Viereck. The female lacks the conspicuous white abdominal hair bands characteristic of *D. spinifera* and the male differs in details of the fore and hind tibiae. Both sexes have more finely carinate propodea.

Dufourea dentipes n. sp.

Male.—Length about 12 mm., length of anterior wing 7.5 mm.; pubescence mostly black; integument almost entirely jet black with occasional very faint reflections of blue or copper on head; body robust.

Head: Face a little over three-fourths as long as broad; eyes strongly diverging below, their length two-thirds the distance between them at antennal insertion; face, viewed directly from in front, with distance between posterior ocelli no greater than from one of them to posterior margin of vertex; posterior ocelli cut by imaginary line drawn between upper eye margins; distance from antennal socket to clypeus about half socket diameter; clypeus sparsely pubescent, with mostly black hairs basally, mixed black, white apically, surface closely punctured, the apical margin strongly convex; supra-clypeal area with a low tubercle near clypeal margin just laterad to antennal socket; frons moderately finely, closely punctured, punctures anterior to ocelli mostly separated by much less than one puncture width, those in concave area lateral to ocelli and behind median ocellus sometimes separated by one or more puncture widths; interpunctural areas reticulate; antennae of moderate length, about reaching tegulae; flagellum black, slightly clavate, three-fourths as broad at base as at apex, all segments longer than broad but only slightly so except second, last; outer, under side of flagellar segments three to eight each with a row of black hairs, never more than ten in number per segment, bent at their middles, the longest two-thirds flagellar width, those of segments seven, eight short, inconspicuous; scape at least three times as long as broad; maxilla with stipes shorter than hind tibia, no longer than eye; galea three times as long as broad, rounded apically; maxillary palpus extending two segments beyond galea, about half as long as stipes, the first segment two and one-half times as long as broad, as long as second, about twice as long as any of remaining; labial palpus as long as first four maxillary palpal segments together, the first six times as long as broad, over twice as long as second, first two as long as first two maxillary palpal segments, last two together three-fourths as long as first *Thorax:* Mesoscutum evenly, rather finely, closely punctured, the punctures nearly contiguous and interpunctural areas roughened, surface rather densely pubescent with numerous short pale hairs obscured by long black ones; wings rather strongly stained with grey, yellow, the first transverse cubital vein nearly contiguous with first recurrent; legs somewhat swollen, modified; fore metatarsus, tibia with numerous short white hairs in additoin to the long black ones; apical tooth of mid tibia short, straight, blunt; second, third tarsal segments of fore leg about as long as broad, fourth broader than long; hind trochanter with inner side produced subapically into a rounded hump, causing the segments to be slightly broader than long; hind femur swollen but not broadened; hind tibia considerably broadened, with subapical ventral tooth, the segment a little less than three times as long as broad, its pubescence nowhere more than half as long as tibial breadth; hind metatarsus nearly four times as long as broad, following segment nearly twice as long as broad, the penultimate as broad as long. *Propodeum:* Enclosure dull, minutely wrinkled, appearing granular, the wrinkles transverse on posterior margin. *Abdomen:* Tergites strongly reticulate but nearly impunctate, the punctures separated by many puncture widths and generally setigerous; apical tergite borders black; bases of tergites, when exposed, with short white hair fringes; apical tergite with well differentiated, median, glabrous, wrinkled area encompassing entire tergite breadth on apical

half, its terminus weakly emarginate; second sternite broadly swollen just basad to middle; third, fourth with rather strongly convex apical margins, sharp, inwardly directed, prostrate hooklets sub-laterally about one-third distance from apex to base; fifth nearly truncate apically; sixth with median, shining, glabrous, depressed, triangular area situated at base of broad, elevated, median area of sternite, with surface bearing dense, short pubescence, its sides rounding in sharply at sub-apex of sternite proper, then extending posteriorly to form a bi-lobed, flat, but laterally carinate, projection which is broader than long, nearly as long as middle of sternite proper; posterior arms of seventh slightly narrower basally than their basal ventral flaps, broadly rounded apically, provided with lateral hair tufts; apical projection of eighth basally broadened, narrowest along middle half, broadened apically to twice narrowest width, not more than one-fourth basal width.

Female.—Length about 10 mm., length of anterior wing 7.5 mm.; pubescence almost entirely black; integument entirely jet black; body robust. *Head:* Face three-fourths as long as broad, eyes diverging below, their length three-fourths the distance between them at antennal insertion; face, as viewed directly from in front, with distance between posterior ocelli no greater than from one to posterior vertex margin; distance from antennal socket to clypeus about half socket diameter; anterior margin of clypeus strongly rounded, surface coarsely punctured, punctures averaging about one of their diameters apart, sub-lateral basal corner with triangular, impunctate, brownish callosity; labrum with polished disk sharply pointed apically; supra-clypeal area, cheeks with few short whitish hairs; frons moderately coarsely, quite densely punctured, punctures nearly contiguous except along lower, inner eye margins and on slightly concave area laterad to posterior ocelli where they are more separate; interpunctural areas reticulate; antennal flagellum black. *Thorax:* Posterior lateral angle of pronotum with pale pubescence; mesoscutum densely, uniformly punctured, punctures rather fine, separated by much less than one puncture width, occasionally sub-contiguous, surface with marginal greyish pubescence, otherwise with complete but sparse, long black pubescence; apical bristles of fore, mid femora black or fumose; mid tibial spur about ten times as long as broad, straight, entirely dark reddish brown, with twelve teeth, basal three very small, apical three broad, separated by more than their lengths; tibial scopa dense, coarse, black, appressed. *Propodeum:* Enclosure satiny, entirely covered with minute longitudinal carinae; imaginary line drawn through middle cutting nearly one hundred. *Abdomen:* Tergites reticulate, nearly impunctate, the punctures fine, setigerous, separated by many puncture widths according to density of pubescence; impressed apical tergite borders black; elevated bases of tergites, when extended, with very short but complete white hair fringes, tergal pubescence otherwise black, not forming hair bands; anal fimbria black.

Holotype: Hasting's Natural History Reservation, Santa Lucia Mts., Jamesburg, Monterey Co., Calif., May 24, 1938, (C. D. Michener), *Allotype:* Bass Lake, Madera Co., Calif., June 9, 1937, (B. E. White). *Paratypes:* 23 males, 5 females, same place as holotype, May 14, 22, 24, 25, 1938, from *Calochortus*, *Stachys*, (C. D. Michener); 2 males, same

locality as allotype, June 8, 1938, (Carl T. Sierra); 1 female, Santa Paula, Ventura Co., Calif., May 22, 1936; 1 male, Mt. Hamilton, Santa Clara Co., Calif., April 26, 1913, (J. C. Bridwell); 1 female, Marsh Creek Springs, Contra Costa Co., Calif., May 12, 1937, (G. E. Bohart); 2 males, Northfork, Madera Co., Calif., June 7, 1933, (B. E. White); 1 male, Mokelumne Hill, Calaveras Co., Calif., March 5, 1893, (J. C. Bridwell); 1 female, Palo Alto, Calif., May 19, 1940, (E. S. Ross).

There is no significant variation in the type series. In some specimens the propodeum appears granulose unless examined carefully. This is a very distinct species, probably belonging to the *maura* (Ckll.) group which includes *dilatipes* Bohart, *campanulae* (Ckll.), and probably *calochorti* (Ckll.). The male can be easily recognized by its sixth sternite which has a bilobed process and by the tooth on the hind tibia.

Dufourea dilatipes n. sp.

Male.—Length about 9 mm.; length of anterior wing 7 mm.; integument intensely jet black, dull, reticulate; pubescence mostly black to dark brown; body robust. *Head:* Face thirteen-fifteenths as long as broad; eyes strongly divergent below, their length less than two-thirds the distance between them at antennal insertions; face, viewed from in front, with postocellar distance greater than distance between posterior ocelli; area laterad to posterior ocelli depressed; distance from antennal socket to clypeus two-thirds socket diameter; clypeus nearly flat, gently rounded at apical margin, punctured as frons, covered with erect black hair but with pale brown ones on margin; punctures of frons in general less than one puncture width apart but much sparser in areas in front of and laterad to ocelli and behind eyes; antenna short, not reaching beyond tegula, black to dark brown; scape two and one-half times as long as broad; flagellum with underside, especially basal half, with numerous straight pale hairs, not confined to rows, about one-fourth as long as flagellar width, thirty or more on basal segments; maxilla with stipes as long as hind tibia; galea two-fifths as broad as long; maxillary palpus four-sevenths as long as stipes, the first segment nearly half as broad as long, as long as second, one-fourth its length longer than any of remaining segments; labial palpus slightly longer than first four maxillary palpal segments, the first about twice as long as second which is a little longer than third or fourth. *Thorax:* Mesoscutum rather finely punctured, the marginal areas with punctures from one to two puncture widths apart, the central disk shining, with punctures from three to five widths apart; mesoscutal pubescence long, dark brown, erect; mesoscutellar and mesepisternal pubsecence hoary from some angles; wings slightly yellowish, the first transverse cubital vein contiguous with first recurrent; legs expanded and especially the hind ones strongly modified; fore, mid tibiae thickened, about two-fifths as broad as long; fore metatarsus slightly more than twice as long as broad; hind trochanter produced posteriorly into triangular lobes; hind femur globose, five-eighths as broad as long; hind tibia nearly three-fourths as broad as long, broadly truncate apically, with rather short pubescence; hind metatarsus over three times as long as broad, succeeding segments as broad as long, produced posteriorly. *Propodeum:* Enclosure finely rugocarinate laterally, rather coarsely rugose medially, appearing

granular posteriorly. *Abdomen:* Tergites reticulate, with numerous very fine, setigerous punctures; tergites five and six with complete subapical hair bands; third and fourth sternites each with a pair of sublateral recurved hooklets near the apical margin; fourth with a flat, downcurved, median, apical, triangular projection; fifth deeply emarginate apically, the emargination nearly truncate; sixth with a median polished plate, broader than long and a heavy, black, rudder-like, median, apical projection, laterally clothed with long black hair; posterior arms of seventh greatly expanded and thickened apically, clothed with wooly grey-brown pubescence; posterior projection of eighth downcurved, with a heavy apical knob twice as broad as base; genitalia with gonostylus and gonocoxite slender, merged together.

Female.—Length 9 mm.; length of anterior wing 6 mm.; integument and pubescence as in male but with short basal white hair fringes on abdomen; body robust. *Head:* Shape of face as in male but more rounded in profile, with longer, less flattened clypeus, and shorter postocellar space; clypeus, median to apical tubercles, with less than 50 rather coarse punctures; facial punctation otherwise similar to male; antenna colored as in male; facial pubescence entirely black, long. *Thorax:* Punctation and pubescence similar to male; wing with first transverse cubital vein offset from first recurrent by one-third its own length; legs heavy with pubescence black basally to brown and golden on tarsi; mid tibial spur with fine close set teeth; tibial scopa dense, black. *Propodeum:* Enclosure appearing finely granular laterally and feebly, irregularly carinate medially. *Abdomen:* Tergites with numerous tiny, setigerous punctures; subapical black hair bands sparse and complete only on tergite five; tergite bases with short white hair bands, hidden medially except on tergite four which is extended; anal fimbria sooty brown to black.

Holotype, allotype, 2 male and 2 female *paratypes:* Two Medicine Lodge, Glacier National Park, Montana, July 6, 1938 (E. C. Van Dyke); 2 female and 9 male paratypes, Lake St. Marys, Glacier National Park, Montana, July 7 and June 1, 1938, and July 3, 1930 (all E. C. Van Dyke); 2 male and 5 female *paratypes*, Waterton Lakes Nat. Park, Alberta, July 11, 1923, (E. H. Strickland).

The type series shows variation in the propodeum, the sculpturing varying from rugose medially to feebly carinate and the lateral areas varying from finely carinate to granular. One male has considerable white hair on the clypeus.

This belongs to the *D. maura* (Ckll.) group but may be distinguished from related species in both sexes by the sculpturing of the propodeum and in the male by the peculiar leg development.

NEW OR INSUFFICIENTLY-KNOWN CRANE-FLIES FROM NEW CALEDONIA[1]

(Diptera: Tipulidae)

PART I

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The major island of New Caledonia, southernmost of the Melanesian Islands, lies in the Pacific Ocean about 875 miles east of Queensland, Australia. It has a length of 248 miles, with an average width of 31 miles, including an area of 8548 square miles, or slightly larger than Massachusetts.

The first crane-flies to be collected on New Caledonia were secured in 1928 by Professor and Mrs. T. D. A. Cockerell. A few scattered specimens were taken during the succeeding five years but the first important collection was one made by Dr. F. X. Williams in 1940 (Alexander, C. P. New or little-known Tipulidae from New Caledonia (Diptera). Proc. Hawaiian Ent. Soc., 12: 235–244; 1945). During the second World War many American troops were stationed on the island for varying periods of time and as a result of the interest of two entomologists, Mr. Charles F. Remington and Mr. John C. Herron, a large and representative series of the Tipulidae of the island became available. These were discussed in detail in a major paper that is still unpublished (Alexander, C. P. The crane-flies of New Caledonia (Diptera, Tipulidae). Trans. Royal Ent. Soc. London; in press). After this latter report was submitted for publication, still further specimens of these flies have become available, chiefly through the diligent efforts of Monsieur Louis R. Garrigou. Most of these latter specimens have been taken at relatively low altitudes on Mont Mou, in the southern part of the island, near Paita. I am very deeply indebted to Monsieur Garrigou for his appreciated efforts to make known the evidently rich Tipulid fauna of New Caledonia. All types of the novelties described at this time are preserved in my personal collection of these flies. A few further specimens are in the United States National Museum, collected by Mr. Wilfred Crabb, and sent to me for naming through the interest of Dr. Stone.

In the major paper above cited a total of 24 generic and subgeneric groups in the Tipulidae were recorded from New Caledonia. At this time I am adding six further generic and subgeneric groups, as follows (the asterisk indicates that the group is new to the island):

**Dolichopeza* Curtis.
Limonia Meigen; *subgenus *Discobola* Osten Sacken.
**Austrolimnophila* Alexander.
**Rhabdomastix* Skuse.
Erioptera Meigen; *subgenus *Meterioptera* Alexander.
**Toxorhina* Loew; *subgenus *Ceratocheilus* Wesche.

[1]Contribution from the Entomological Laboratory, University of Massachusetts.

It may be regarded as certain that intensive collecting will add further generic groups to the island list, as at present known. In the United States National Museum (Lot 42–3133) there is a specimen of *Conosia irrorata* (Wiedemann), labelled "New Zealand; New Caledonia?—in airplane. Honolulu No. 23,632." This widespread fly has not been recorded from New Caledonia, New Zealand or the Hawaiian Islands, yet is regional (Fiji; eastern Australia; New Guinea).

Genus **Phacelodocera** Enderlein

Phacelodocera margaritae Alexander

Phalacrocera margaritae Alexander; Trans. Royal Ent. Soc. London (in press).

Allotopotype, ♀, Mont Mou, New Caledonia, altitude 900 feet, April, 1947 (L. R. Garrigou).

Female.—Length about 33 mm.; wing 24 mm.; antenna about 5.5 mm.

Characters as in the male, differing in the structure of the antennae. Antennae 15-segmented; flagellar branches much shorter than in the male, the longest not exceeding three times the length of the segment; first flagellar segment with a single branch, subequal to the segment, placed beyond midlength; flagellar segments two to nine, inclusive, each with two basal branches but without the third branch of the male sex; branches slightly unequal, the outer about one-third to one-half longer than the inner and slightly stouter; outer four segments simple, or the first (flagellar segment ten) with a swelling or protuberance on outer face; terminal segment about one-half longer than the penultimate. Ovipositor with the valves elongate, the cerci very slender, much exceeding the hypovalvae.

Genus **Dolichopeza** Curtis

Dolichopeza (Dolichopeza) austrocaledonica sp. n.

General coloration of mesonotum yellowish brown with three darker brown praescutal stripes; anterior vertex narrow; wings with a brownish tinge, stigma oval, darker brown; Sc_1 preserved; *Rs* very short, lying far distad, beyond the level of the other elements of the anterior cord; *r-m* strongly arcuated; cell M_1 deep; *m-cu* about its own length before the fork of *M;* cell *2nd A* relatively broad; male hypopygium with the outer dististyle long and narrow, nearly five times as long as the greatest width.

Male.—Length, about 8 mm.; wing, 9 mm.; antenna (to end of segment seven) 4 mm.

Frontal prolongation of head dark brown; palpi black. Antennae relatively long, as shown by the measurements; scape, pedicel and first flagellar segment brownish yellow, the remainder of flagellum dark brown; flagellar segments long-cylindrical, with scattered unilaterally arranged verticils, the longest a trifle more than one-third the length of the segment; antennae broken at end of seventh segment. Head brown; anterior vertex relatively narrow, a little less than twice the diameter of the scape.

Pronotum brown. Mesonotal praescutum with the ground yellowish brown, with three darker brown stripes that are only a little darker

than the ground; scutum brownish yellow, the lobes patterned with brown; scutellum dark brown, parascutella paler; mediotergite paler yellowish brown, the pleurotergite still more yellowed. Pleura more yellowed dorsally, the ventral portion, also involving the posterior coxae, infuscated. Halteres with the stem pale, knob infuscated. Legs with the fore and middle coxae paler than the posterior pair; trochanters yellow; remainder of legs broken. Wings with a brownish tinge, cell *Sc* a trifle more yellowed; stigma oval, darker brown, occupying the space between *Rs* and vein R_2; veins brown. Venation: Sc_1 preserved, at the extreme tip of Sc_2; *Rs* very short, lying far distad and simulating a crossvein, lying just distad of the level of the tip of Sc_1; *r-m* strongly arcuated to subangulate at near midlength; cell M_1 deep, nearly three times its petiole; *m-cu* about its own length before the fork of *M;* cell *2nd A* relatively broad.

Abdomen feebly bicolored, the broad bases and apices of the individual segments dark brown, the intermediate part more reddish brown or yellow; subterminal segment more uniformly dark brown; hypopygium brownish yellow. Male hypopygium with the outer dististyle relatively long and slender, the length nearly five times the greatest width, the entire surface with relatively few long black setae. Inner dististyle with the beak a flattened pale blade, the tip obtuse; lower beak blackened, even broader and more obtuse.

Habitat: New Caledonia. Holotype, ♂, Mont Mou, altitude 900 feet, February, 1947 (Garrigou).

In its venation, particularly the distal position of *Rs*, the present fly is more like certain Papuan species of the subgenus, all of which have cell *2nd A* very narrow. In general appearance it somewhat resembles the Australian *Dolichopeza* (*Dolichopeza*) *longifurca* Skuse and *D.* (*D.*) *pallidiitarsis* Alexander, which differ in the venation and in the structure of the male hypopygium. The genus had not been recorded from New Caledonia.

Genus **Limonia** Meigen

Subgenus **Discobola** Osten Sacken

Limonia (Discobola) caledoniae sp. n.

Size large (wing, male, over 16 mm.); mesothorax chiefly black, the praescutum brownish yellow with four brownish black stripes on the posterior portion; both the femora and tibiae black with a subterminal yellow ring; wings brownish fulvous, patterned with darker brown and yellow, the latter chiefly as series of dots along the veins; costal fringe of short setae from small blackened tubercles; abdominal segments bicolored; male hypopygium with the tergite oval, its caudal border convex.

Male.—Length, about 13 mm.; wing, 16.5 mm.

Rostrum and palpi black. Antennae black, the pedicel a trifle more testaceous; flagellar segments long-oval. Head brownish black, sparsely pruinose; anterior vertex reduced to a narrow strip; head narrowed behind.

Cervical region blackened. Pronotum brown, variegated with brownish black, with a sparse yellow pollen. Mesonotal praescutum

obscure brownish yellow, with four brownish black stripes, the intermediate pair more intense, restricted to slightly more than the posterior half of the sclerite and only a little longer than the lateral stripes; anterior and lateral praescutal borders darkened; posterior sclerites of notum black, the centers of the scutal lobes vaguely more brightened; central portion of scutum and base of scutellum more brownish black, opaque; mediotergite paler at proximal end. Pleura black, the sternopleurite somewhat paler. Halteres black, the base of stem narrowly pale. Legs with the fore and middle coxae black, the tips narrowly yellow; posterior coxae with the outer half yellowed; trochanters obscure yellow; femora brown, the base slightly paler, apex and a subterminal ring narrowly yellow, enclosing a broader black anteapical annulus; tibiae brownish black with a narrow yellow subterminal ring, the blackened apex even narrower; tarsi brownish black; claws with a single tooth; setae of legs relatively short. Wings with a strong fulvous brown tinge, variegated with darker brown and yellow areas; the brown pattern includes large costal areas alternating with subequal yellow ones, the third dark mark ocelliform, at the fork of *Sc;* vein *Cu* with a brown seam in cell *M*, broken by yellow dots; remaining veins with series of yellow dots, at ends of veins R_3 to M_4, inclusive, appearing as delicate marginal semicircles; anterior prearcular field obscure yellow; veins brown, those in the anterior fields of the wing alternating with yellow sections in the brightened portions. Costal fringe of short setae from small blackened tubercles. Venation: Sc_1 ending shortly before the fork of *Rs*, Sc_2 near its tip; *Rs* strongly arcuated at origin; free tip of Sc_1 joining R_{1+2} at nearly a right angle; vein R_{4+5} deflected strongly caudad near tip, ending close to wing apex; cell *1st* M_2 elongate, irregular in outline, *m* being about one-third as long as the angulated basal section of M_3; *m-cu* shortly before fork of *M;* supernumerary crossvein in cell *1st A* gently sinuous, more than twice the distal section of vein *2nd A*.

Abdominal segments bicolored, the apical third of each dark brown or brownish black, the basal portion obscure yellow, becoming more brownish yellow on the outer segments; lateral borders of segments more narrowly darkened; hypopygium yellow. Male hypopygium with the tergite oval in outline, with both the caudal and cephalic borders convexly rounded. Basistyle with the ventromesal lobe large, applied to the entire mesal face of the style, near the outer end on lateral portion with a low secondary tubercle. Dorsal dististyle a very gently curved black rod, its tip acute. Ventral dististyle relatively small, without evident rostral spines. Gonapophyses appearing as double paired blades on either side of the slightly longer aedeagus, the inner blade more slender on its outer portion.

Habitat: New Caledonia. Holotype, ♂, Mont Mou, altitude 900 feet, June, 1947 (Garrigou).

Limonia (*Discobola*) *caledoniae* is entirely distinct from the more than 20 species of the subgenus so far made known. In some regards it suggests *L.* (*D.*) *ampla* (Hutton) and *L.* (*D.*) *dohrni* (Osten Sacken), of New Zealand, but the resemblance is not at all close. The subgenus had not been recorded from New Caledonia.

At this time I am re-naming a preoccupied species in this same subgenus: *Limonia* (*Discobola*) *gibberina* nom. nov.; for *L.* (*D.*) *gibbera*

Edwards, 1923, of New Zealand; *nec L.* (*Dicranomyia*) *gibbera* Alexander, 1916. (*Discobola gibbera* Edwards; Trans. N. Z. Inst., 54: 286; 1923. *Dicronomyia gibbera* Alexander; Trans. Amer. Ent. Soc., *42:* 6–7; 1916.)

Genus **Helius** St. Fargeau

Helius (Helius) aphrophilus sp. n.

General coloration of thorax dark brown; rostrum unusually long, approximately one-third the remainder of body; legs black, the tarsi paler; wings with a faint grayish tinge, restrictedly patterned with brown.

Male.—Length, excluding rostrum, about 5.5–6 mm.; wing, 6–7 mm.; rostrum about 1.8–2 mm.

Female.—Length, excluding rostrum, about 7.5–8 mm.; rostrum about 2–2.2 mm.

Rostrum elongate, black throughout. Antennae black, short; basal flagellar segments oval, the outer ones passing through elongate-oval to cylindrical; verticils slightly longer than the segments. Head black; anterior vertex narrow, subequal to the diameter of scape.

Thorax almost uniformly dark brown; vestiture of praescutal interspaces elongate but scattered. Halteres infuscated, the extreme base of stem yellow. Legs with the coxae dark brown; trochanters a little paler; remainder of legs black, the tarsi paling to light brown or brownish yellow. Wings with a faint grayish tinge, restrictedly patterned with brown, as follows: A spot at origin of *Rs* and another more basad in cell *R* at near one-third the length of cell; stigma; very narrow seams over cord and outer end of cell *1st* M_2; tip of vein R_3; wing tip less evidently darkened; veins brown. Venation: *Sc* long, Sc_1 ending a short distance before fork of *Rs*, Sc_2 longer than Sc_1; *r-m* subequal to or a little longer than the basal section of R_{4+5}; cell *1st* M_2 small, pentagonal, much shorter than the veins beyond it; *m-cu* at or close to the fork of *M;* cell *2nd A* relatively wide.

Abdominal tergites dark brown; sternites brown with posterior borders obscure yellow; subterminal segments more uniformly pale; hypopygium with the basistyles obscure yellow, the remainder dark brown. Male hypopygium with the basistyle unarmed. Outer dististyle relatively short and straight, the tip very indistinctly bifid. Inner dististyle longer, stout, the outer fourth somewhat more narrowed, the outer margin with several strong tubercles that bear strong setae. Gonapophyses with the lower apical angle extended into a long straight spine.

Habitat: New Caledonia. Holotype, ♂, Mont Mou, altitude 900 feet, December, 1946 (Garrigou). Allotopotype, ♀, pinned with type. Paratypotypes, several ♂♂, December, 1946, to March, 1947 (Garrigou); paratypes, ♂♀, St. Louis, altitude 1100 feet, December 2–30, 1945 (Herron), hanging on under faces of wet rocks in cascades and rapids of stream and on stones near waterfalls; ♂♀, near La Foa, February 26–April 25, 1945 (Remington).

The only other regional species having the rostrum elongate is *Helius* (*Helius*) *neocaledonicus* Alexander, which is readily told by the

larger size and the unpatterned wings. The present fly seems to prefer wet boulders near waterfalls and rapids, whence the specific name.

Genus **Austrolimnophila** Alexander

Austrolimnophila garrigoui sp. n.

General coloration brownish black, patterned with yellow; legs black, both the femora and tibiae very narrowly ringed with yellowish white, the tarsi paling to obscure yellow; wings strongly infuscated, with a conspicuous pattern of still darker brown, these latter areas bordered by cream-yellow; *Rs* square and short-spurred at origin; *m-cu* at near two-thirds the length of cell *1st* M_2; abdomen brownish black, the segments ringed posteriorly with pale.

Female.—Length, about 9 mm.; wing, 9.5 mm.

Rostrum brownish black; palpi black. Antennae (female) short; scape and pedicel black, the former pruinose; basal three flagellar segments yellow, the remainder black; flagellar segments becoming long-cylindrical, with elongate verticils that exceed the segments. Head brown, more or less yellow pollinose.

Pronotum brown, somewhat darker on the sides. Mesonotal praescutum black with two intermediate light brown stripes that are separated by a shiny black capillary vitta, the sublateral stripes and lateral border blackened; scutum light brown, each lobe variegated with brownish black spots; scutellum blackened basally, more pruinose on posterior border; postnotum black, heavily gray pruinose; a capillary dark central vitta on the mediotergite. Pleura and pleurotergite with the ground obscure brownish yellow, conspicuously patterned with black, including a complete dorsal stripe, the broad bentral sternopleurite, and a broken intermediate stripe appearing on the dorsal sternopleurite and again on the ventral pleurotergite. Halteres long and slender, dusky, the base of stem and apex of knob whitened. Legs with the coxae black, more or less pruinose basally, the tips whitened; fore coxae with the extreme base again black; trochanters brownish yellow; femora black, obscure yellow basally, with three narrow rings of yellowish white, these rings at near one-third, two-thirds and the tip, respectively; tibiae black, similarly with three narrow yellowish white rings, involving the base and tip and a similar annulus at near one-fifth the length; tarsi brownish black, paling into obscure brownish yellow. Wings with the ground strongly infuscated, with a conspicuous pattern of darker brown, all these areas ringed with cream-yellow to produce a handsome pattern; the dark marks include four in the prearcular field; at arculus, extending anteriorly to *C;* origin of *Rs*, extending from *C* almost to *M;* a band at cord, extending from *C* back to *M*, more narrowed behind; seams over outer end of cell *1st* M_2, *m-cu*, R_2, fork of M_{1+2}, and at ends of all longitudinal veins; two further dark areas in cell *2nd A*, at base and at near midlength; veins yellow in the brightest fields, elsewhere becoming brownish yellow and finally dark brown in the patterned portions. Venation: *Rs* square and short-spurred at origin; R_{2+3+4} about one-half longer than the basal section of R_5; R_{1+2} about three times R_2; cell M_1 nearly twice its petiole; *m-cu* at near two-thirds the length of cell *1st* M_2.

Abdomen brownish black, the posterior borders of the segments ringed with pale, very narrowly so on the tergites, more broadly so on the sternites. Genital shield black, valves of ovipositor horn-yellow.

Habitat: New Caledonia. Holotype, ♀, Mont Mou, altitude 900 feet, February, 1947 (Garrigou).

This beautiful and exceptionally distinct crane-fly is named for the collector, Louis Robert Garrigou, who has added materially to our knowledge of the Tipulidae of New Caledonia. Superficially the fly suggests certain species of *Epiphragma* in Tropical America, while being quite dissimilar to the two species of this latter genus so far discovered in New Caledonia. There is no trace of the supernumerary crossvein in cell *C*, characteristic of all species of *Epiphragma*. The genus *Austrolimnophila* is new to the island list.

Genus **Gynoplistia** Westwood

Gynoplistia (Paralimnophila) neocaledonica Alexander

Gynoplistia (*Paralimnophila*) *neocaledonica* Alexander; Proc. Hawaiian Ent. Soc., 12: 240–242, figs. 4, 8; 1945.

2 ♀ ♀, Mont Mou, New Caledonia, altitude 900 feet, March, 1947 (Garrigou).

Gynoplistia (Paralimnophila) caledonica sp. n.

Mesonotal praescutum fulvous in front, brown behind, the surface more or less pruinose; antennal flagellum brownish yellow; femora yellow, with two narrow dark brown rings, both subterminal; tibiae yellow, the apex narrowly brownish black; wings whitish subhyaline, restrictedly patterned with medium brown, the areas restricted to the vicinity of the veins; cell R_3 sessile or very short-petiolate.

Male.—Length, about 12 mm.; wing, 10.5 mm.

Rostrum dark gray; palpi brownish black; labial palpi obscure orange. Antennae with the scape brown, sparsely pruinose; pedicel paler brown; flagellum brownish yellow, the segments subcylindrical, slightly longer than the verticils. Head dark, heavily gray pruinose, the center of the posterior vertex and the occiput with a brown median spot.

Pronotum light brown, sparsely gray pruinose; pretergites pale yellow. Mesonotal praescutum in front fulvous, behind brown, more or less pruinose and patterned with still darker brown stripes, including a median vitta that is even more blackened and continues to the cephalic border of the sclerite; scutum infuscated; scutellum testaceous brown with a darker median vitta; mediotergite light gray, with a narrow more blackened central stripe; pleurotergite gray. Pleura yellow, including the dorsopleural membrane. Halteres uniformly yellow. Legs with the coxae pale yellow, sparsely pruinose; trochanters yellow; femora yellow, with two narrow dark brown rings, one nearly terminal, the other subapical, the two annuli separated by a much broader ground ring; tibiae yellow, the tips narrowly brownish black; tarsi yellow. Wings whitish subhyaline, restrictedly patterned with medium brown, as follows: A spot at origin of *Rs*, with a second larger area in transverse alignment in cells *Cu* and *1st A;* a more basal spot in cell *R;* stigma and a complete seam crossing the wing, the stigma slightly darker; outer end of cell

1st M_2; spots at fork of $M_{1\ 2}$ and tips of veins R_3 and R_4; veins yellow, darker in the clouded portions. Venation: *Sc* moderately long, Sc_1 ending shortly before the fork of *Rs*, Sc_2 a short distance before the tip; *Rs* elongate, exceeding its anterior branch, cell R_3 sessile or very short-petiolate; vein R_{2+3+4} and basal section of R_5 interstitial or virtually so; *r-m* short or obliterated by fusion of veins R_5 and M_{1+2}; cell *1st* M_2 rectangular; cell M_1 subequal to or a little shorter than its petiole; *m-cu* about one-fourth its length beyond the fork of *M*.

Basal abdominal tergite brownish black medially, the margins yellow; succeeding tergites obscure yellow; a subterminal brownish black ring; hypopygium and preceding segment yellow. Male hypopygium with the tergite narrowed outwardly, its caudal margin very gently emarginate. Outer dististyle slender; inner style more or less mitten-shaped, the tip obtuse.

Habitat: New Caledonia. Holotype, ♂, Mont Mou, altitude 900 feet, April, 1947 (Garrigou).

Most similar to *Gynoplistia* (*Paralimnophila*) *neocaledonica* Alexander, differing conspicuously in the coloration of the antennae, legs and wings and in the venation.

Gynoplistia (Gynoplistia) williamsiana Alexander

Gynoplistia (*Gynoplistia*) *williamsiana* Alexander; Proc. Hawaiian Ent. Soc., 12: 242–243, figs. 5, 9; 1945.

This is apparently the commonest and most widely distributed member of the genus in New Caledonia. Conception, November 8–11, 1944; Dumbea, October 14–29, 1944; Noumea, September 10, 1944 (all Wilfred Crabb); United States National Museum. Mont Mou, altitude 900 feet, June, 1947 (Garrigou).

Genus **Rhabdomastix** Skuse

Rhabdomastix austrocaledoniensis sp. n.

Size very small (wing under 3.5 mm.); mesonotal praescutum and scutum brownish yellow, heavily gray pruinose, the posterior sclerites and the pleura clearer yellow; legs brown; wings with a light grayish tinge, veins pale brownish yellow; no macrotrichia on *Rs* or its anterior branch; Sc_1 ending about opposite three-fifths the length of *Rs;* distance on costa between R_{1+2} and R_3 subequal in length to the latter vein; cell *1st* M_2 small.

Sex? Length, about 2.7–2.8 mm.; wing, 3–3.3 mm.

Specimens damaged by Corrodentia. Head brownish yellow. Mesonotal praescutum and scutum brownish yellow, heavily light gray pruinose; scutellum and postnotum clearer yellow; lateral border of praescutum and the pretergites yellow. Pleura yellow, in cases weakly more infuscated. Legs with the coxae and trochanters yellow; remainder of legs brown. Wings with a light gray tinge, the costal border a trifle more yellowed; veins pale brownish yellow. No macrotrichia on *Rs* or its anterior branch; relatively abundant coarse trichia on R_5, excepting its base, and on distal ends of outer sections of veins M_{1+2} and M_3. Venation: Sc_1 ending about opposite three-fifths the length of *Rs;*

R_{2+3+4} about three times the slightly oblique to suberect vein R_3; distance on costa between R_{1+2} and R_3 subequal in length to the latter vein; distal section of vein M_{1+2} gently arcuated at its base; cell *1st* M_2 small, about one-third as long as the distal section of vein M_{1+2}; *m-cu* at near one-third the length of cell *1st* M_2.

Habitat: New Caledonia. Holotype, Sex?, Mont Mou, altitude 1100 feet, June, 1947 (Garrigou). Paratopotypes, 2 fragmentary specimens.

Rhabdomastix austrocaledoniensis is quite distinct from the relatively numerous species of the genus now known from Australia and New Zealand, being distinguished by the unusually small size and by the venation and trichiation of the wings. This widespread genus had not hitherto been recorded from New Caledonia.

Genus **Erioptera** Meigen

Subgenus **Meterioptera** Alexander

Erioptera (Meterioptera) caledonia sp. n.

Thorax brownish yellow, the pleura clearer yellow; basal fusion of flagellar segments apparently involving two segments; legs yellow, the outer tarsal segments blackened; wings grayish yellow; Sc_1 very long, nearly equal to *Rs;* R_{2+3+4} and R_{2+3} in oblique alignment; vein *2nd A* very strongly sinuous on its outer fourth.

Male.—Length, about 3.5 mm.; wing, 3.5–3.7 mm.

Female.—Length, about 4 mm.; wing, 4–4.2 mm.

Rostrum yellow; palpi brownish black. Antennae with the scape, pedicel and basal flagellar segments yellow, the outer ones slightly darker; basal fusion of flagellar segments apparently involving two articles, the remaining ones oval, with long conspicuous verticils. Head obscure yellow.

Thorax brownish yellow, the pretergites and pleura clearer yellow. Halteres with stem yellow, knob weakly darkened. Legs with all coxae and trochanters yellow; remainder of legs yellow, the outer tarsal segments black. Wings grayish yellow, the prearcular and costal fields pale yellow; veins yellow, those comprising the cord slightly darker yellowish brown. Venation: Sc_1 ending opposite the fork of *Rs*, Sc_2 only a short distance beyond the origin of *Rs*, Sc_1 thus very long, nearly equal to *Rs*, the latter long; R_{2+3+4} in alignment with R_{2+3}, both oblique; *m-cu* just before the fork of *M;* vein *2nd A* with the outer fourth strongly sinuous, running close to the wing margin.

Abdominal tergites brown, the sternites and genital segment more yellowed.

Habitat: New Caledonia. Holotype, ♀, Mont Mou, altitude 900 feet, February, 1947 (Garrigou). Paratopotypes, several ♂ ♀, February–June, 1947 (Garrigou).

The present fly is most similar to Australian species, such as *Erioptera* (*Meterioptera*) *illingworthi* Alexander, differing in the small size, and in the details of coloration and venation. The subgenus *Meterioptera* is new to the island list.

Genus **Molophilus** Curtis

Molophilus (Molophilus) vorax sp. n.

Belongs to the *gracilis* group and subgroup; general coloration dark brown; antennae short; wings with a weak dusky tinge; costal fringe (male) long and conspicuous; male hypopygium with the basistyle terminating in three lobes, the dorsal one a slender spine; outer dististyle a strongly sinuous rod; inner style more flattened, nearly parallel-sided, its lower apical angle produced into an acute blackened spine.

Male.—Length, about 3 mm.; wing, 3.5 mm.

Rostrum and palpi dark brown. Antennae (male) short, if bent backward not attaining the wing root; scape pale, the remainder of organ dark brown; flagellar segments subcylindrical, with truncated ends, shorter than the longest verticils. Head dark brown.

Thorax almost uniformly dark brown, the sides of the praescutum and the pleura a trifle paler. Halteres with the stem darkened, narrowly pale at base, knob broken. Legs brownish yellow, with dark vestiture, the outer tarsal segments more darkened. Wings with a weak dusky tinge, the veins and macrotrichia darker brown. Costal fringe (male) long and conspicuous. Venation: R_2 lying shortly distad of level of *r-m;* petiole of cell M_3 a little more than twice the straight *m-cu.*

Abdomen, including hypopygium, dark brown or brownish black. Male hypopygium with the mesal and ventral apical lobes of the basistyle fleshy, setiferous, the dorsal one a slender spine of nearly the same length. Two dististyles occupying the notch of the basistyle, the outer a strongly sinuous or sigmoid rod, its base thickened, the outer half or more extended into an elongate black spine. Inner dististyle a flattened parallel-sided rod, the lower apical angle produced into an acute blackened spine, the upper apical portion with microscopic appressed spinulae. Aedeagus stout at base, narrowed very gradually to the slender tip.

Habitat: New Caledonia. Holotype, ♂, Mont Mou, altitude 900 feet, February, 1947 (Garrigou). Paratopotype, ♂, on slide, March, 1947 (Garrigou).

The only other regional member of the group is ***Molophilus*** (***Molophilus***) ***tartarus*** Alexander, which has the male hypopygium entirely different in structure.

Genus **Toxorhina** Loew

Subgenus **Ceratocheilus** Wesche

Toxorhina (Ceratocheilus) caledonica sp. n.

Rostrum very long, much exceeding the wing; disk of mesonotum dark brown, the cephalic and lateral portions of the praescutum yellow; pleura yellow, striped longitudinally with brownish black; halteres yellow; legs dark brown; wings weakly tinged with brown, restrictedly patterned with darker brown, appearing as seams along the cord and elsewhere; anterior branch of *Rs* sinuous, relatively long; cell *1st* M_2 closed; abdominal tergites bicolored, dark brown, with a narrow obscure yellow crossband at near midlength of each.

Female.—Length, excluding rostrum, about 9 mm.; wing, 6 mm.; rostrum, about 8.3 mm.

Rostrum unusually long, as shown by the measurements, much exceeding the wing, black throughout. Antennae with the scape dark; remainder of organ broken. Head yellowish gray; anterior vertex without corniculus, relatively narrow, less than the diameter of the rostrum; setae of vertex relatively numerous and strong, chiefly proclinate.

Cervical region and pronotum brownish black. Mesonotal praescutum projecting strongly over the pronotum, the cephalic and lateral portions yellow, contrasting abruptly with the remainder of disk which is dark brown; posterior sclerites of notum similarly darkened, sparsely pruinose. Pleura whitish yellow, striped longitudinally with brownish black, the broadest and most conspicuous stripe dorsal in position, extending from the pronotum across the dorsal pleurites to the abdomen, passing through the root of the halteres; ventral sternopleurite less heavily infuscated. Halteres pale yellow. Legs with the coxae whitish yellow; trochanters brown; remainder of legs dark brown, the tarsi not or scarcely brightened. Wings with a weak brownish suffusion, the prearcular and basal costal area somewhat more yellowed; a relatively conspicuous brown pattern, appearing as seams to *Rs*, cord, anterior branch of *Rs*, base of outer section of vein R_5 and as a seam along *Cu*, chiefly in cell *M;* cells *C* and *Sc* more brownish yellow; veins brown, paler at wing base. Macrotrichia on outer radial and medial veins, sparse or lacking on M_4. Venation: Sc_1 ending about opposite one-third the length of *Rs*, Sc_2 nearly opposite the origin; *Rs* more strongly arcuated than in most other regional species; anterior branch of *Rs* sinuous, relatively long; cell *1st* M_2 closed, shorter than M_4; *m-cu* at or just beyond the fork of *M;* cell *2nd A* relatively wide.

Abdomen with the tergites bicolored, dark brown, with a relatively narrow obscure yellow transverse band at near midlength, both base and apex darkened; sternites more uniformly pale yellow, the posterior borders narrowly margined with dark brown. Ovipositor with the genital shield dark brown; valves of ovipositor dark chestnut brown, very long, especially the slender nearly straight cerci.

Habitat: New Caledonia. Holotype, ♀, Mont Mou, altitude 900 feet, March, 1947 (Garrigou).

A very distinct species, readily told from others in New Guinea, Australia and New Zealand by the coloration of the body and wings. It is entirely different from the species next described. In its venation it is most like species such as *Toxorhina* (*Ceratocheilus*) *australasiae* Alexander but very distinct. Both the genus and subgenus were unrecorded from New Caledonia.

Toxorhina (Ceratocheilus) juvenca sp. n.

Mesonotum light brown, the posterior sclerites gray; head light gray; legs brown, with black vestiture; wings with a weak brownish tinge, unpatterned; *Rs* and basal section of vein R_5 subequal in length; anterior branch of *Rs* longitudinal in position, sinuous, about twice as long as *Rs;* cell *2nd A* very narrow.

Sex? Length, excluding rostrum, about 4.5 mm.; wing, 4 mm.; rostrum, about 4.2 mm.

Rostrum brown throughout, exceeding the wing in length. Antennae with the scape and pedicel yellow; flagellum broken. Head light gray; no corniculus; anterior vertex relatively broad, approximately four times the diameter of scape.

Pronotum fulvous yellow. Mesonotum light brown, paling to fulvous at the produced cephalic end, the lateral praescutal borders pale; scutal lobes light brown, the remainder of mesonotum gray; posterior margin of scutellum and lateral portion of mediotergite brown. Pleura brownish gray, the sternopleurite somewhat paler. Halteres with stem brown; knob broken. Legs with the coxae and trochanters light yellow; trochanters testaceous yellow; remainder of legs brown, with black vestiture. Wings with a weak brown tinge, unpatterned; veins dark brown. Venation: *Sc* short, Sc_1 ending about opposite one-fourth to one-fifth the length of *Rs*, Sc_2 opposite this origin; *Rs* subequal in length to basal section of R_5 and only about one-half as long as its anterior branch, the latter longitudinal in position, sinuous; distance on costa between the tips of veins R_{1+2} and R_3 slightly greater than the length of *Rs* alone; cell *1st* M_2 subrectangular, M_{3+4} subequal to vein M_4; *m-cu* shortly before the fork of *M;* cell *2nd A* very narrow, striplike.

Abdomen with basal segments brown, bordered by dark brown; outer segments broken.

Habitat: New Caledonia. Holotype, Sex? Mont Mou, altitude 900 feet, April, 1947 (Garrigou).

The present fly is readily told from the only other regional member of the genus and subgenus, ***Toxorhina* (*Ceratocheilus*) *caledonica*** sp. n., by the small size and unpatterned wings, with all venational details distinct.

THE ENTOMOLOGICAL SOCIETY OF AMERICA

PROCEEDINGS OF THE FORTY-SECOND ANNUAL MEETING

Chicago, Illinois, December 27-30, 1947

The Entomological Society of America held its forty-second annual meeting Saturday through Tuesday, December 27–30, 1947, in conjunction with the annual meeting of the American Association of Economic Entomologists and the American Association for the Advancement of Science. Headquarters for the Entomological meetings were in the Congress Hotel. Attendance for the two Entomological meetings was almost 500 and about 400 attended the Entomologists' Banquet.

The program presented at the four-day meeting follows:

Saturday Morning, December 27, 10:00 A. M.

Registration of entomologists at entrance of Florentine Room.

Saturday Afternoon, December 27, 1:30 P. M.

JOINT SESSION WITH TEACHING SECTION OF THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Dr. Alvah Peterson presided at the session and introduced President Metcalf, who announced the appointment of the following committees:

Nominating Committee—Al Boyce, R. E. Traub, H. B. Hungerford, Chairman.

Resolutions Committee—B. D. Burks, F. A. Fenton, C. W. Sabrosky, Chairman.

The following program was presented:

What Constitutes Good Training in Entomology.
- For the New Fields of Entomology........................C. W. Kearns
- For Teachers..C. E. Mickel
- For Regulatory and Quarantine Service.....................E. R. Sasscer
- Open Discussion: Should a Standard for Training be Formulated? Leader, R. C. Smith

Methods of Teaching.
- Insect Toxicology................................W. M. Hoskins
- Apiculture..V. G. Milum
- Adult Taxonomy....................................H. E. Jacques
- Larval Taxonomy...................................Alvah Peterson

The Relationship between Teaching Loads and Experiment Station Work in Entomology..Dwight Isely

The Professional Placement of Entomology Graduate Students, J. T. Creighton

Sunday Morning, December 28

10:00 A. M.—JOINT MEETING WITH AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

President Metcalf called the meeting to order and introduced

Dr. E. N. Cory, President of the American Association of Economic Entomologists, who delivered his Presidential Address.

At the end of this joint session, the two Societies met separately for the remainder of the morning.

11:00 A. M.—GENERAL SESSION: EXPLANATION OF EXHIBITS

President Metcalf opened the meeting, which consisted of an explanation of the various exhibits on display.

1. Microbiological assay technique for the determination of vitamin and amino acid content of insect tissues. HENRY DEVLIN THOMAS, North Park College.
2. A new method of rearing *Drosophila*. A. C. HODSON and H. C. CHIANG, University of Minnesota.
3. Material for larval studies. ALVAH PETERSON, Ohio State University.
4. A convenient and satisfactory storage system for student reference collections. R. L. POST, North Dakota State College.
5. Entomological illustrations with the aid of a substage lamp and projection prism. R. L. POST, North Dakota State College.
6. Equipment for using cockroaches in quantitative physiological studies. JERRE L. NOLAND and J. H. LILLY, University of Wisconsin.

Description of the exhibits followed. The exhibits were extremely interesting and were left in place until Tuesday afternoon.

Sunday Afternoon, December 28, 1:30 P. M.

GENERAL SESSION

PRESIDENT METCALF, *Presiding*

1. Entomological courses offered by United States colleges and universities. (10 min.) P. C. STONE, University of Missouri.
2. A dust proof filing system for entomological publications (6 min.). J. ALEX MUNRO, North Dakota State College.
3. A preliminary report on insects of Bikini Atoll (10 min.). A. C. COLE, JR., University of Tennessee.
4. Psychodidae Genitalia: terminology and study techniques (7 min., illus.). WILLIAM F. RAPP, JR., Doane College.
5. Immature stages and biology of the mosquito, *Megarhinus septentrionalis* D. & K. (15 min., illus.). OSMOND P. BRELAND, University of Texas.
6. Terminology of braconid wings (10 min., illus.). GARLAND T. RIEGEL, University of Illinois.
7. Breeding of *Aedes sollictans* in abandoned rice fields in South Louisiana (15 min., illus.). E. S. HATHAWAY, Tulane University.
8. Recent investigations on the relationship of fruit flies infesting cherries in the West (10–15 min., illus.). S. C. JONES, Oregon State College.
9. Adaptations in fleas, with special reference to the aedeagus (15 min., illus.). MAJOR ROBERT TRAUB, U. S. Army.
10. Larval and pupal characters in *Physonota* (Chrysomelidae) (5 min., illus.). MILTON W. SANDERSON, Illinois Natural History Survey.
11. Biological requirements for rearing cat fleas in the laboratory. WILLIS N. BRUCE, Illinois Natural History Survey.
12. Equipment for using cockroaches in quantitative physiological studies. JERRE L. NOLAND and J. H. LILLY, University of Wisconsin.

Sunday Evening, December 28, 6:30 P. M.

The Entomological Banquet was held in the Casino with Dr. Harlow B. Mills as toastmaster. At the end of the banquet, Dr. R. L. Patton gave a very interesting talk on "The Application of Radio-Active Elements to Entomology."

Monday Afternoon, December 29, 1:00 P. M.

PHYSIOLOGY SESSION

J. FRANKLIN YEAGER, *Presiding*

1. Insect vision; a review (15 min., illus.). L. J. MILNE, University of New Hampshire.
2. The effect of temperature on the hatching of eggs of the northern walking stick (15 min., illus.). A. C. HODSON, University of Minnesota.
3. Plant hormones (auxins) as a factor in the hatching of *Aedes trivittatus* (Coquillett) eggs (10 min., illus.). ALBERT ABDEL-MALEK, Ohio State University.
4. Chemically induced transformations of organ systems in insects (15 min., illus.). DIETRICH BODENSTEIN, Medical Research Laboratory, Edgewood Arsenal, Maryland.
5. The endocrinology of diapause in the *Cecropia* silkworm (15 min., illus.). CARROLL M. WILLIAMS, Harvard University.
6. Qualitative analysis of amino acids in insect blood (15 min., illus.). JOHN J. PRATT, JR., Cornell University.
7. The microbiological assay of *Notonecta* spp. (and other insects): quantitative determination of amina acid and vitamin content by use of Lactobacillus spp. (10 min., illus.). HENRY DEVLIN THOMAS, North Park College.
8. Physiology of tracheal filling in *Sciara* (10 min., illus.). MARGARET L. KEISTER, National Institute of Health.
9. Respiration of *Phormia* in relation to DDT (10 min., illus.). JOHN B. BUCK and MARGARET L. KEISTER, National Institute of Health.
10. A study of certain metabolic intermediates in the DDT poisoned housefly adult (15 min., illus.). PAUL A. DAHM, Kansas State College.
11. The metabolic fate of DDT in the milkweed bug (10 min., illus.). WILLIAM C. FERGUSON, Pittsburgh Plate Glass Company.
12. The influence of Ryania extract on the metabolism of the cockroach (10 min., illus.). G. A. EDWARDS, K. D. ROEDER, and ELIZABETH WEIANT, Tufts College.
13. The temperature coefficients of DDT action (15 min., illus.). H. Y. FAN, T. H. CHENG and A. G. RICHARDS, University of Minnesota.
14. Synopses in the insect nervous system (15 min., illus.). KENNETH D. ROEDER, Tufts College.
15. A ratio hypothesis pertaining to the biological action of poisons and drugs (10 min., illus.). J. FRANKLIN YEAGER, U. S. D. A., B. E. P. Q., and SAM C. MUNSON, George Washington University.
16. Relationships between time lags and responses to temperature (15 min., illus.). NELLIE M. PAYNE, American Cyanamid Company, Stamford, Connecticut.
17. The action of DDT upon lipoidal films, W. M. HOSKINS and A. Z. FATHY.
18. Respiratory studies on homogenized insect tissues by means of the Warburg apparatus. (by title). ELSIE L. COLE, University of Wisconsin.

TAXONOMY SESSION

E. GORTON LINSLEY, *Presiding*

1. Static vs. dynamic nomenclature (15 min., illus.). Z. P. METCALF, North Carolina State College.
2. On citing distribution of North American Insects (10 min., illus.). J. C. BRADLEY, Cornell University.
3. Considerations on the spider genus *Dictyna* Sundevall (10 min.). SARAH E. JONES, Texas State College for Women.
4. The genus *Cymatia* (Corixidae-Hemiptera) (7 min., illus.). H. B. HUNGERFORD, University of Kansas.
5. The nomenclature of the orders of the Apterygota (15 min.). CHARLES L. REMINGTON, Harvard University.
6. Description of the larvae of some ruteline beetles with keys to tribes and genera (Scarabaeidae) (10 min., illus.). PAUL O. RICHTER, University of Kentucky.
7. Genitalic differences in the sawfly genus *Periclista* (Tenthredinidae) (10 min., illus.). LEWIS J. STANNARD, Illinois Natural History Survey.
8. Whither nomenclature? (15 min.). CURTIS W. SABROSKY, U. S. D. A., B. E. P. Q.

Monday Evening, December 29, 8:00 P. M.

ANNUAL PUBLIC ADDRESS

The Annual Public Address of the Entomological Society of America, by Dr. Alfred E. Emerson, University of Chicago, was on the subject, "Zoogeography of Termites."

Dr. Emerson illustrated his excellent address with a zoogeographic presentation of the known distribution of the various termite groups.

Tuesday Morning, December 30, 9:00 A. M.

JOINT SESSION WITH THE ECOLOGICAL SOCIETY OF AMERICA

ORLANDO PARK, *Presiding*

1. A notable aggregation of Collembola (by title). ORLANDO PARK, Northwestern University.
2. Observations upon the ecology of the Phalangida of the Chicago area (10 min., illus.). MARIE V. O'BRIEN, Chicago, Illinois.
3. A preliminary analysis of the response of centipedes to differential amounts of moisture (15 min., illus.). STANLEY I. AUERBACH, Northwestern University.
4. The effect of different relative humidities on the development of the horned Passalus (15 min., illus.). I. E. GRAY, Duke University.
5. Modal temperatures of the greenhouse whitefly *Trialeurodes vaporariorum* and its parasite *Encarsia formosa* (10 min., illus.). THOMAS BURNETT.
6. Some relations of aqautic insects to plants of the genus *Potamogeton* (15 min., illus.). CLIFFORD O. BERG, University of Michigan.
7. A biologically annotated list of the Buprestidae of the lower Rio Grande Valley, Texas (15 min., illus.). GEORGE R. VOGT, Pharr, Texas.
8. The zoogeography of American Conopisthinae (Araneida: Ther.) (10 min.). HARRIETT E. FRIZZELL, University of Texas.
9. Comparative population studies of the long-tailed mealybug and its natural enemies on citrus (15 min., illus.). PAUL DE BACH, University of California.
10. The seasonal occurrence of mayflies (Ephemeroptera) (12 min., illus.). JUSTIN W. LEONARD, University of Michigan.
11. Notes on the distribution and ecology of the pseudoscorpions of Illinois (10 min., illus.). C. CLAYTON HOFF, University of New Mexico.
12. Ecology of the chiggers affecting man in the United States (Acarina, Trombiculidae) (15 min., illus.). DALE W. JENKINS, Army Chemical Center, Edgewood, Maryland.

Tuesday Afternoon, December 30, 1:30 P. M.

BUSINESS MEETING

President Metcalf called the meeting to order and asked for the report of the Secretary.

REPORT OF THE SECRETARY

Executive Committee Activities:

PRESIDENT METCALF nominated Mr. C. F. W. MUESEBECK for membership on the Organizing Committee for the Congress of Tropical Medicine, to represent the Entomological Society of America.

On March 26, PRESIDENT METCALF appointed PROFESSOR R. W. HARNED as a representative of the Society to the organizing board of the American Institute of Biological Sciences.

On May 16, the Secretary served as delegate of the Society at the installation of GEORGE DINSMORE STODDARD as president of the University of Illinois.

Twenty-four new members were elected to membership in the Society by mail ballot of the Executive Committee.

Annual Executive Committee Meeting:

Convened on the evening of December 27 at 7:30, in joint session with the Executive Committee of the Association of American Economic Entomologists. Most of the material discussed was referred to later separate discussion. One item was agreed upon at that time, that the committee would recommend following the outline of meeting places adopted last year. The next meeting is therefore planned for New York City during the second week of December.

After this the Executive Committee continued with Society business.

1. Thirty-three new members were elected as new members of the Society.

2. The following members have resigned during the year: Otto Ackerman, W. C. Allee, Lawrence M. Bartlett, R. A. Blanchard, Clyde A. Dennis, Lorin Roy Gillogly, Anita Hoffman, John M. Hutzel, H. R. Jennings, E. T. Jones, S. Marcovitch, Arthur C. Mason, J. R. Parker, Frank M. Semans, Septima C. Smith, J. S. Stanford, I. B. Tarshis, Roy T. Webber, R. W. Wells, and Harley F. Wilson. The following members have been dropped from membership because of failure to pay dues or because they cannot be reached: Paul Anduze, Wm. R. Cobb, J. P. Kislanko, Jean Paul Picard, Merrill K. Riley, Philip Schroeder, J. K. G. Silvey, Vicente Velasco.

3. The following were elected as Fellows of the Society: Floyd Andre, Richard Bohart, Melvin Griffith, M. H. Haydak, W. M. Hoskins, Clyde Kearns, A. B. Klots, John T. Medler, L. J. Milne, E. S. Ross, H. Ruckes, R. G. Schmieder, O. E. Tauber, and Wm. Trager.

4. The Society has suffered the loss by death of the following nine members: T. D. A. Cockerell, R. W. Glaser, V. R. Haber, J. S. Houser, W. S. Marshall, W. N. Nushawg, Philip A. Readio, A. G. Ruggles, Franklin Sherman, and H. H. Whall.

5. The following were elected to fill the three vacancies of the Editorial Board: C. W. Sabrosky, M. W. Sanderson, and C. D. Michener.

6. To fill the two vacancies in the Thomas Say Foundation for a period of two years, C. F. W. Muesebeck and Herbert H. Ross were renominated and elected.

7. It was voted to contribute $100.00 to the support of Zoological Record.

8. It was voted to assist the American Society of Naturalists with the financing of the Biologists' Smoker, as indicated in correspondence between Wilson S. Stone, Section of the ASN, and the Secretary of the Entomological Society.

9. Nominations of the American Committee on Entomological Nomenclature were confirmed, naming P. W. Oman, C. D. Michener, and C. S. Walley, to fill three vacancies now existing in that Committee.

10. Recommendations were made on reports of the Committee on Insect Physiology and the Joint Committee on History. These will be given at the time of presentation of these reports.

Respectfully submitted,

Herbert H. Ross, *Secretary.*

TREASURER'S REPORT

December 2, 1946, to December 22, 1947

Current Fund

Balance on hand December 2, 1946	$2,357.09
Receipts	7,078 17
Total	$9,435 26

EXPENDITURES

Annals (five numbers)	$7,054.84
Expenses of the Secretary-Treasurer's office, including costs of Richmond meeting	282.85
Travel expense	135.85
Checks returned and bank charges	27.01
To Zoological Society of London for Zoological Record	100.05
To International Commission of Zoological Nomenclature	50.05
To American Committee of Entomological Nomenclature	33.03
Total	$7,683.68

Permanent Fund

Balance as of December 2, 1946	$4,596.23
Interest and Bond coupons	16.44
Liberty Bond	50.00
Total	$4,662.67

Total Resources of Society

Balance in Current Fund	$1,751.58
Balance in Permanent Fund	4,662.67
Total	$6,414.25

Respectfully submitted,

Herbert H. Ross, *Treasurer.*

It was moved and seconded that the Treasurer's report be adopted as read, subject to the approval of the auditing Committee. Motion carried.

REPORT OF THE MANAGING EDITOR

During the past year the amount of material received for publication in the Annals has been approximately what we could publish in a volume of reasonable size, hence there has been little opportunity to select and diversify the contents of the issues and the December issue will contain an unusual number of short articles. Since it was prepared for the press, with a rather meager amount of copy available, a rather large number of manuscripts have been received to give us a good start for 1948.

This situation is gratifying in view of the continued increase in the cost of printing. The invoice for the September issue showed a cost of approximately $8.00 per page, in contrast with our former favorable rate of $5.50 which persisted until well into the war years. Until economic conditions improve we may be faced with the need for limiting the size of the Annals because of sheer cost. At present, in actual cost to the Society, we are returning to our members in the Annals more than four dollars out of their five dollars dues.

This return is possible only through substantial sales of back volumes. We have been fortunate this year, probably because of orders which would have been placed earlier but for the war. These sales, together with the generous policy of the Gorgas Memorial Foundation, which pays the full cost of publication of articles by its associates, have made the year financially very successful.

Our favorable balance has also been aided by Dr. William Procter's generous continuation of his annual contribution of $500.00.

As will be seen in the financial statement below, these circumstances left the editor with a balance of $3044.66 when the books were closed. Of this sum, $2500 have been transferred to the Treasurer. An apparent discrepancy in this statement between the sum paid to the engravers and the amount received from authors for cuts is due to the fact that the September issue was mailed late, so that remittances for cuts printed in it are outstanding, as well as those for the December issue, although we have paid the engravers for this material.

In trying to evaluate the current trends, the editor foresees that sales may very well fall off during the next few years and that the cost of publication may still rise somewhat. While curtailing the size of the Annals may be a necessary step in meeting these conditions, it seems also that the Society might do well to consider securing lower costs and possibly some revenue from advertising. Although we have never carried advertisements, a few pages might very easily be secured from publishers and dealers in entomological supplies.

The editor regrets that this report must be his swan song. His position as a teacher and department head cannot be unique, since all colleges are now heavily loaded, but it is such that he cannot do justice either to Denison or to the Annals under present conditions. He has thoroughly enjoyed the editorship and thanks the Society for the opportunity to carry it for these three years. And in resigning he wishes to reiterate and to emphasize a need to which Dr. C. H. Kennedy called attention while he was editor. The extent of business transactions involved in publishing the Annals has become too great for one man to handle as a labor of love—unless he has private means to free him from the need of earning a living. It might be possible in a larger institution than Denison if the editor could secure the part-time services of a competent stenographer who could also handle our small amount of bookkeeping, and some help, possibly from dependable graduate students, for making up orders and wrapping them for shipment. Otherwise it seems imperative that the duties be divided between an editor and a business manager. Under that arrangement it would be far better for both to be in the same institution so that they could work together conveniently.

Financial Statement

December 19, 1946—December 10, 1947

RECEIPTS	
Non-member subscriptions and sales from Columbus office	$1,768.91
Sales of back numbers	798.29
Gift of Dr. William Procter	500.00
From authors for cuts	580.48
Gorgas Memorial Foundation, cuts and printing	476.18
Bank balance Dec. 1, 1946	1,501.32
Total	$5,625.18
DISBURSEMENTS	
Engraving	$1,001.71
Postage	143.76
Stationery, wrappers and miscellaneous supplies	65.40
Refunds on subscriptions (chiefly duplicated orders)	29.90
Stenographic and addressograph service	339.50
Transferred to treasurer, Dec., 1946	1,000.00
Bank charge	.25
Balance in Peoples State Bank, Granville, O., Dec. 10, 1947	3,044.66
Total	$5,625.18

Respectfully submitted,

A. W. Lindsey, *Managing Editor.*

It was moved and seconded that the Managing Editor's report be accepted as read, subject to the approval of the Auditing Committee. Motion carried.

REPORT OF THE TREASURER OF THE THOMAS SAY FOUNDATION

RECEIPTS

Balance on hand December 1, 1946	$3,643.25	
1946 sales paid in 1947	13.00	
1947 sales of Volume I—7 @ $3.00	21.00	
1947 sales of Volume I—1 @ $2.70	2 70	
1947 sales of Volume II—7 @ $5.00	35.00	
1947 sales of Volume II—4 @ $4.50	18,00	
1947 sales of Volume III—4 @ $4.00	16 00	
1947 sales of Volume III—1 @ $4.15	4.15	
1947 sales of Volume III—1 @ $3.60	3.60	
1947 sales of Volume III—1 @ $3.53	3.53	
1947 sales of Volume III—1 @ $3.00*	3.90	
Interest to June 30, 1947	36.54	
Total Receipts		$3,799.77

*$1.00 rebate on advertising.

EXPENDITURES

Postage	$ 2 81	
Due on 1947 sales	32.10	
Total Expenditures		34.91
Balance		$3,764.86
Balance in Purdue State Bank, December 23, 1947		$3,764 86

Respectfully submitted,

J. J. DAVIS, *Editor and Treasurer.*

It was moved and seconded that the report of Editor and Treasurer of the Thomas Say Foundation be adopted as read, subject to the approval of the Auditing Committee. Motion carried.

REPORT OF THE AUDITING COMMITTEE

We, the undersigned members of the Auditing Committee, beg to report that we have carefully examined the accounts of H. H. Ross, Treasurer of the Society; J. J. DAVIS, Treasurer of the Thomas Say Foundation, and A. W. LINDSEY, Managing Editor of the Annals, for the year 1947, and have found them to be correct and properly balanced.

The accounts of the Treasurer of the Society were examined by W. V. BALDUF; those of the Treasurer of the Thomas Say Foundation by B. E. MONTGOMERY, and those of the Managing Editor of the Annals by A. M. DEWEY.

Respectfully submitted,

A. M. DEWEY,
B. ELWOOD MONTGOMERY,
W. V. BALDUF, *Chairman.*

It was moved and seconded that the report of the Auditing Committee be adopted as read. Motion carried.

FINAL REPORT OF THE INSECT PHYSIOLOGY COMMITTEE

At the 1945 annual business meeting in St. Louis of the ESA, this committee was set up by the President of the society for the purpose of starting, if possible, a journal of insect physiology.

The Committee obtained from a number of publishers estimates of possible cost of publication of a journal of insect physiology. The estimates were made as of May, 1946, and on the assumption that the proposed journal would have a format comparable to that of the Journal of Cellular and Comparative Physiology, would appear quarterly, and would total about 500 pages per annual volume. On the basis of these estimates, the committee concluded that annual cost of

publication, including necessary stenographic, postage, and incidental expenses, would amount to $5,000.00. It was assumed that services of editor and editorial board would be without salary.

This committee is agreed that the establishment of a journal of insect physiology of high standard, available as a place of publication, regardless of society affiliations, for all who do basic research in insect physiology, biochemistry, biophysics, or on mode of action of poisons on insects, would be of enduring benefit to entomology as a whole. The willingness of various insect physiologists, who are not members of either the ESA or the AAEE to participate in the insect physiology program of the society, is evidence that a section of physiology within the ESA could serve as a focal point for fundamental work of this sort, to the profit of both insect physiology and the broader field of general entomology. A failure to do so may mean that the bulk of such research will become centered elsewhere. The committee feels that the Entomological Society of America does well to encourage the participation of non-member physiologists in its insect physiology programs, and to work toward the establishment, on a sound financial basis, of an insect physiology journal of high standard.

In view of this, the committee wishes to make two recommendations:

RECOMMENDATION 1

The formation of a permanent Insect Physiological Section to have sessions every year at the annual meeting of the Society.

a. That this Section be under the management of a committee of three, consisting of chairman, vice-chairman, and secretery.

b. That these be appointed annually by the Executive Committee.

c. That the program of the sessions consist of papers, special discussions, or other features in the field of insect physiology, according to the discretion of the committee.

RECOMMENDATION 2

That a Journal of Insect Physiology be established to publish papers on insect physiology, biochemistry, biophysics, and mode of action, etc.

a. That a permanent committee of the Society be formed, to be known as the Insect Physiology Foundation, empowered to proceed with financing and publication of the journal. This Foundation shall be similar to the Thomas Say Foundation in its relations and responsibilities to the Society.

b. That this committee shall consist of a managing editor and an editorial board of six members. Each member of the committee shall be elected for a term of six years. It is recommended that for any one person, consecutive terms of office be limited to two.

c. For the purposes of initialing the Foundation, it is recommended that the initial editorial board be made up of two members to serve six years, two to serve four, and two to serve two. This will result in the retirement of two board members each two years.

Figures on cost and a conservative study of sales indicate that this Journal would be able to start with the help of only a comparatively small outlay, and would be self-supporting within approximately a year.

This committee therefore recommends that a sum of $1,000 be appropriated to initiate this Journal. It is understood that this sum would be returned to the Society when the Journal is solvent and in a going condition.

Respectfully submitted,

CLYDE W. KEARNS,
A. GLENN RICHARDS,
J. FRANKLIN YEAGER, *Chairman.*

The Executive Committee placed before the meeting its recommendation that the Report of the Insect Physiology Committee be adopted, that $1,000 be appropriated from the Permanent Fund for the establishment of the Journal of Insect Physiology, and the Committee continue to function until it names the initial editorial staff of this Journal. Considerable discussion ensued and the Committee was praised for its

courage in going ahead with this difficult undertaking. After the discussion it was moved and seconded that the recommendation of the Executive Committee be adopted, and the motion was carried unanimously.

After this, Dr. R. W. Harned opened the subject of the Entomological Society joining the American Institute of Biological Sciences. Dr. Harned recommended that the Society consider this very seriously. Dr. Neil Stevens gave a frank discussion of the subject, readily admitting that the movement was a gamble in many respects but expressed the thought that it could be a worthwhile one and well worth a chance. The Executive Committee report was given, in which it was pointed out that there were several objections to the proposal including duplication of dues that would devolve on individuals belonging to several societies, that the benefits were extremely indefinite, and that it would be necessary to circularize the membership to raise the dues in order to pay the membership fee. The Executive Committee felt that the Society was definitely interested in this type of organization but in view of the objections and difficulties suggested that we investigate the matter further to clarify these issues and that a committee be appointed for this purpose. It was moved and seconded that this be put in form of a motion and be adopted. Motion carried.

At the suggestion of J. M. Hutzel of the AAAS it was moved and seconded that Society representatives on the Council of the Association be elected for three years and that an alternate be nominated also. Motion carried.

REPORT OF THE JOINT COMMITTEE ON THE PREPARATION OF A HISTORY OF ENTOMOLOGY IN RELATION TO WORLD WAR II

DECEMBER, 1947

1. The American Association of Economic Entomologists and the Entomological Society of America, at the annual meetings held in Richmond, Va., in December, 1946, passed resolutions calling for the appointment of a joint committee on the preparation of a history of entomology in relation to World War II.

2. The committee appointed for this purpose has accomplished the following:

a. Prepared a preliminary outline of the history to serve as a guide in the assembling of information and writing of the report, given below.

b. Prepared and mailed questionnaires regarding war service to entomologists who served in the armed forces. These questionnaires were sent to 415 individuals, and approximately 195 returns were received.

c. Mailed questionnaires to 46 colleges and universities, requesting information concerning entomological contributions to the war effort. Twelve replies have been received.

d. Secured statements of wartime entomological activities from the Tennessee Valley Authority; U. S. Public Health Service Laboratories at Savannah, Ga., and Memphis, Tenn.; Divisions 9 and 10 of the National Defense Research Committee; the Rockefeller Foundation; and seven divisions of the Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. In addition, statements from the Malaria Control in War Areas organization and the U. S. Army Typhus Commission have been promised.

e. Requested statement concerning entomological contribution of approximately 20 industrial concerns. Responses were received from eight firms.

3. Much additional work remains to be done in collecting, tabulating and analyzing data; in the assembling of the data obtained; and in writing the manuscript.

4. In view of the above, the following recommendations are made:

a. That MR. E. C. CUSHING be appointed general editor to secure any additional data that are required, analyze the information obtained, and assemble and edit the history. (See Note 1.)

b. That the sponsoring societies authorize the expenditure of $1,000 to pay the editor selected for his time and travel expenses, and to cover clerical assistance required in writing the history.

c. That a joint committee of four be appointed to assist the editor and to serve as an advisory board in the preparation and publication of the history.

d. That the history be printed and issued as a joint publication of the two sponsoring societies, following the general format of the Annals of the Entomological Society of America.

e. That cost of publication be met by the two sponsoring societies, utilizing any special funds now available or that may become available for this purpose.

Note 1. Informal inquiry indicates that MR. CUSHING would be willing to assume this responsibility under conditions recommended in paragraph 4*b*. It is believed that his writing ability, familiarity with federal and state agencies and industrial concerns, his experience as a commissioned officer during the war and general contacts with the many phases of wartime entomology, qualify him for the task.

Note 2. The American Association of Economic Entomologists mimeographed the questionnaires (2200 sheets) and the Entomological Society of America provided funds to the extent of $21.29 for postage, preparation of correspondence, addressing and mailing of questionnaires. It is believed this is a reasonably equitable division of expenses involved in the activities of the committee.

OUTLINE OF HISTORY OF ENTOMOLOGY IN RELATION TO WORLD WAR II

I. Introduction. Brief history of entomology.
   a. Prior to World War I.
   b. During World War I.
   c. Between World War I and World War II.

II. Entomological Activity During World War II.
   a. Contributions of entomologists serving with the Armed Forces.
   b. Direct contributions of non-military entomologists to the Armed Forces.
   c. Entomology in relation to national health and economy.

III. Critical Analysis of Entomology in Relation to the War Effort.
   a. Status of entomology at the beginning of World War II.
   b. Appraisal of entomological activity during World War II.

IV. Recommendations.

STANLEY W. BROMLEY,
RALPH W. BUNN,
EDWARD F. KNIPLING,
PAUL W. OMAN, *Chairman.*

The report was read by Dr. Oman who moved its adoption. After considerable discussion a substitute motion was made and seconded that the recommendation of this committee be referred to the Executive Committee which be authorized to make expenditures according to its judgment to further this *History*. It was further stipulated that this motion pertained only to preparing the manuscript and implies no guarantee regarding publication, which question was deferred for consideration until the manuscript is completed. Motion carried.

ANNUAL REPORT OF THE JOINT AMERICAN COMMITTEE ON ENTOMOLOGICAL NOMENCLATURE

During the year 1947 the American Committee on Entomological Nomenclature concluded its study of several problems referred to it by American entomologists. The first of these involved the question of misidentified genotypes. The applicant was advised to follow Opinions 65 and 168 of the International Commission on Zoological Nomenclature in dealing with this problem. The second question, concerning the status of names placed upon the "Official List of Generic Names in Zoology" resulted in the conclusion that there are apparently two kinds of names on the "Official List," those which had been added in the absence of objections from zoologists at the time when they were considered, and those which had been added through the exercise of the Plenary Power of the International Commission. These two classes of names are regarded as having quite different status. The third case involved the valid name of the Dipterous family Ortalidae *auctt.* The applicant was advised of the apparent application of the International Rules of Zoological Nomenclature in this case, but further action, including possible representation to the International Commission for suspension of the rules, was left up to the applicant. A fourth study involved certain problems relating to the status of generic names proposed after December 31, 1930, without definite unambiguous designation of the type species. The cases presented included problems considered to be of such importance that a petition requesting clarification has been prepared for submission to the International Commission on Zoological Nomenclature.

In addition to these specific problems, your Committee has expressed its opinion upon a number of matters now pending before the International Commission on Zoological Nomenclature and has prepared a petition to the Commission upon the status to be accorded to names proposed as names for forms of infraspecific rank.

Finally, your Committee has availed itself of the opportunity offered by the presence in this country of MR. FRANCIS HEMMING, Secretary of the International Commission on Zoological Nomenclature, to meet with him and discuss problems of mutual interest.

Any matters of nomenclature which American entomologists wish to refer to the Committee may be directed to its chairman, MR. C. F. W. MUESEBECK, or to the undersigned as Secretary.

Respectfully submitted,

E. G. LINSLEY, *Secretary.*

Dr. Richards introduced a letter and material from the National Society for Medical Research. It was moved and seconded that the Secretary be instructed to write to this Society and express a desire to become a member of it, and to consider this an application for such membership. Motion carried.

President Metcalf read cordial and inspiring letters from Dr. L. O. Howard and Professor Herbert Osborn. It was moved and seconded that the Secretary write to these, and tell them that the letters were greatly appreciated by the Society which sends them the best of wishes for the New Year.

Dr. Fracker gave an informal report on the National Science Foundation and Dr. Mickel gave a report on the AAAS Council meetings.

REPORT OF THE RESOLUTIONS COMMITTEE

1. *Resolved,* That the Society express its appreciation to the Joint Committee for Local Arrangements: GEORGE C. DECKER, chairman; CHARLES SEEVERS, RUPERT L. WENZEL, C. NORMAN DOLD, EDWARD L. THOMAS; to the Officers of the Society; and to the A.A.A.S., particularly to its Equipment Committee headed by DR. VAN NIMAN, for their efforts on behalf of this meeting.

2. *Resolved*, That the Society express its gratitude to the management of the Congress Hotel for numerous courtesies contributing to the success of the meetings.

3. *Resolved*, That the Society express its appreciation to DR. A. E. EMERSON for his scholarly presentation of the Annual Public Address of the Society, on the "Zoogeography of Termites."

4. *Resolved*, That the Society express its sincere regret for the loss through death of several of its members during the past year and that an expression of sympathy be sent to the families of the deceased.

5. *Resolved*, That the sincere appreciation of the Society be expressed to DR. WILLIAM PROCTER for his generous contribution of a sum of $500.00 to the Annals of the Entomological Society of America for the year 1964–1947.

6. *Resolved*, That the Society is gratified to note the continued and increased interest in the session on Insect Physiology; and

7. *Resolved*, That the Society express its appreciation to DR. A. WETMORE and the Smithsonian Institution for making possible the visit to this country of MR. FRANCIS HEMMING, Secretary of the International Commission on Zoological Nomenclature.

Respectfully submitted,

B. D. BURKS,
H. E. MILLIRON,
C. W. SABROSKY, *Chairman*.

It was moved and seconded that the report of the Resolutions Committee be adopted as read. Motion carried.

REPORT OF THE NOMINATION COMMITTEE

Your nominating committee presents the following officers for the coming year:

President.......................................H. H. KNIGHT
First Vice-President..............................E. G. LINSLEY
Second Vice-President............................PAUL OMAN
Secretary-Treasurer...............................HERBERT ROSS

R. E. TRAUB,
AL BOYCE,
H. B. HUNGERFORD, *Chairman*.

After a call for further nominations it was moved and seconded that the nominations be closed and that the Secretary be instructed to cast a unanimous ballot for these offices. Motion carried.

The meeting then adjourned.

THE ENTOMOLOGICAL SOCIETY OF AMERICA

LIST OF MEMBERS

(March, 1948)

In this list, which is arranged alphabetically, members are given in lower case type, Fellows in small capitals and Honorary Fellows in capitals. The year of admission to membership is given before the name, and of election to Fellowship and Honorary Fellowship in parentheses following the address. Names of Life Members are indicated by asterisk (*) and the special field of work in italics. Ch. indicates Charter Member, 1906.

A

'39. Aamodt, T. L., State Entomologist's Office, University Farm, St. Paul, Minn.
'47. Abdel-Malek, Albert, Box 12081, University Station, Columbus 10, Ohio.
'27. Adams, C. F., State Board of Health, Jefferson City. Mo. (F. '29). *Diptera.*
'40. Ahrens, Carsten, 3461 Harrisburg St., Pittsburgh 4, Pa. *Odonata.*
'10. Alexander, Charles P., Massachusetts State College, Amherst, Mass. (F. '20). *Tipulidae.*
'33. Alexander, E. Gordon, Department of Biology, University of Colorado, Boulder, Colo. *Orthoptera.*
'25. Allen, H. W., Box 150, Moorestown, N. J. (F. '40). *Tiphiidae, Tachinidae.*
'42. Allen, Theodore, 2520 Mulberry Ave., Muscatine, Iowa.
'32. Amos, John M., 403 State Office Building, Nashville 3, Tenn. *Coccidae, Cerambycidae.*
'30. Anderson, Edwin J., Frear Laboratory, State College, Pa. *Beekeeping.*
'29. Anderson, Lauren D., Virginia Truck Experiment Station, P. O. Box 2160, Norfolk 1, Va. *Gerridae.*
'47. Anderson, M. L., Virginia Smelting Co., West Norfolk, Va.
'37. Anderson, William H., Room 429, U. S. National Museum, Washington 25, D. C. *Coleopterous larvae.*
'39. Andre, Floyd, College of Agriculture, University of Wisconsin, Madison, Wis. (F. '47). *Thysanoptera.*
'32. Annand, P. N., Bureau of Entomology and Plant Quarantine, Washington, D. C. (F. '39). *Aphids.*
'28. App, Bernard A., Box 297, Fort Valley, Ga. *Economic Entomology.*
'40. Archer, Allan F., Museum of Natural History, University, Ala. *Arachnida*
'23. Armstrong, Thomas, Dominion Entomological Laboratory, Vineland Station, Ontario, Canada. *Scarabaeidae.*
'36. Ashton, Donald F., 2711 Van Dyke Ave., Raleigh, N. C. *Culicidae.*
'37. Assmuth, Rev. Joseph, Fordham University, New York 58, N. Y. *Isoptera.*
'42. Atkins— E. Laurence, Jr., University of California, Citrus Experiment Station, Division of Entomology, Riverside, Calif.
'34. Au, Sung Hin, 1911 Dole St., Honolulu 33, T. Hawaii. *Aphids.*
'33. Avinoff, A., Hidden Valley, Locust Valley, Long Island, N. Y. (F. '39). *Lepidoptera.*

B

'37. Babers, Frank H., P. O. Box 3391, Orlando, Fla. *Physiology.*
Ch. *Back, E. A., Bureau of Entomology and Plant Quarantine, Washington, D. C. (F. '38). *Asilidae, Aleyrodidae.*
'39. Badertscher, A. Edison, 103 Bonnie Hill Road, Towson, Baltimore 4, Md. *Insecticides.*
'21. Baerg, W. J., University of Arkansas, Fayetteville, Ark. (F. '32). *Poisonous Arthropods.*
'30. *Bailey, J. W., 27 Willway Road, Richmond, Va. *Myriapoda.*
'47. Bailey, Norman S., 16 Neponset Ave., Hyde Park 36, Mass. *Tabanidae, Tingidae.*

'11. BAKER, A. C., Apartado Number 3, Colonia Anahuac, D. F., Mexico. (F. '29). *Aphididae, Aleyrodidae.*
Baker, A. W., Ontario Agricultural College, Guelph, Ontario, Canada.
'22. Baker, Howard, Bureau of Entomology and Plant Quarantine, Washington 25, D. C. *Apple and Pecan Insects.*
'36. Baker, Walter C., Carter Memorial Laboratory, P. O. Box 547, Savannah, Ga. *Toxicology.*
'28. BALCH, R. E., Dominion Entomological Laboratory, Fredericton, New Brunswick, Canada (F. '44). *Forest Insects.*
'20. BALDUF, W. V., 308 Harker Hall, University of Illinois, Urbana, Ill. (F. '40). *Entomophagous Insects.*
'45. Ball, William Howard, Box 392, College Park, Md.
'38. Ballou, Charles H., Instituto Experimental de Agricultura, El Valle, Distrito Federal, Venezuela. *Economic Entomology.*
'43. Balock, John W., P. O. Box 2280, Honolulu 4, T. Hawaii.
'08. BANKS, NATHAN, 103 Norfolk St., Holliston, Mass. (F. '14, H. F. '45).
Ch. BARBER, H. G., 143 East Third Ave., Roselle, N. J. (F. '30). *Hemiptera, Lygaeidae.*
Ch. BARBER, H. S., U. S. National Museum, Washington 25, D. C. (F. '28). *Coleoptera.*
'23. Bare, Clarence O., Box 7062, Richmond 21, Va. *Notonectidae.*
'26. BARNES, H. F., Rothamsted Experiment Station, Harpenden Herts, England. (F. '37). *Cecidomyiidae.*
'43. Barnes, Ralph C., U. S. P. H. S., 605 Volunteer Bldg., Atlanta, Ga.
'40. Barnett, Lt. Herbert C., O-529738, Hq. Army Med. Dept. Schools, Fort Sam Houston, Texas.
'47. Barr, William F., Department of Entomology, University of Idaho, Moscow, Idaho. *Buprestidae, Cleridae.*
'39. Barrett, John P., c/o Armour and Company, Department of Chemical Research, Union Stock Yards, Chicago 9, Ill. *Calliphoridae.*
'41. Barrett, Paul H., 441 W. Second St., Apt. 404, Le ington, Ky. *Aquatic Insects.*
'35. Barrett, W. L., Jr., P. O. Box 5687, Stock Yards Station, Kansas City, Mo. *Diptera, Ectoparasites.*
Barro, Manuel, Calle 12 #220, Vedado, Habana, Cuba.
'46. Bartholomai, C. W., 1123 N. 16th St., Lafayette, Ind.
'47. Basham, Ernestine H., Florida State Board of Health, P. O. Box 210, Jacksonville 1, Fla. *Diptera, Culicidae.*
'18. BASINGER, A. J., Citrus Experiment Station, Riverside, Calif. (F. '41). *Calliphoridae.*
'31. BATES, MARSTON, Rockefeller Foundation, Apartado 757, Villavicencio, Colombia (F. '40). *Diptera, Trypetidae.*
'24. BEAMER, RAYMOND H., 1000 Missouri St., Lawrence, Kans. (F. '34). *Homoptera, Cicadellidae.*
'46. Beatie, Russel H., Westvaco Chlorine Products Corp., 405 Lexington Ave., New York 17, N. Y.
'34. Beck, Elmer W., Box 576, Toledo, Ohio. *Parasites European Corn Borer.*
'47. Beck, Stanley D., Department of Zoology, University of Wisconsin, Madison, Wis.
'47. Beckham, Clifford Myron, Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio.
'29. Bedard, W. Delles, 335 Giannini Hall, University of California, Berkeley, Calif. *Scotylidae, Braconidae.*
'20. Bedford, Hugh W., Government Entomologist, Agricultural Research Service, Entomology Section Wad Medani, Sudan, Africa.
'43. BEEBE, WILLIAM, New York Zoological Society, Zoological Park, Bronx Park, New York, N. Y. (F. '44).
'42. Belkin, John N., Department of Biology, Mohawk College, Utica 5, N. Y. *Culicidae, Tabanidae.*
'25. BELL, ERNEST L., 150-17 Roosevelt Ave., Flushing, N. Y. (F. '40). *Hesperiidae.*
'40. Benesh, Bernard, P. O. Box 159, North Chicago, Ill. *Lucanidae.*
Ch. Bentley, Gordon M., 64 Biology Bldg., University of Tennessee, Knoxville 16, Tenn. *Orthoptera.*

'23. Benton, Curtis, 1216 Ball St., Lafayette, Ind.
'17. *BEQUAERT, JOSEPH C., Curator of Insects, Museum of Comparative Zoology, Cambridge, Mass. (F. '34). *Vespidae, Tabanidae.*
'28. Berly, J. A., Division of Entomology, Clemson College, S. C. *Coccidae, Odonata.*
'43. Berner, Lewis, Department of Biology, University of Florida, Gainesville, Florida.
'39. Berry, Paul A., United States Embassy, Paris, France. *Biological Control.*
'34. Bess, Henry A., 623 N. Second St., Milwaukee 3, Wis. *Ecology, Forest Insects.*
Ch. BETTEN, CORNELIUS, 104 Corson Place, Ithaca, N. Y. (F. '37). *Trichoptera.*
'47. Biaggi, Virgilio, Biology Department, College of Agriculture, Mayaquez, Puerto Rico.
'28. Bibby, F. F., Smithville, Miss. *Cicadidae.*
'47. Bick, George H., Department of Entomology, Cornell University, Ithaca, N. Y.
'38. *Bickley, William E., Jr., Laboratories of Biology, University of Richmond, Richmond, Va. *Chrysopidae.*
'25. Bigger, J. H., Natural Resources Bldg., Urbana, Ill. *Plant Resistance to Insect Attack.*
'30. Billings, Samuel C., 8434 Piney Branch Court, Silver Springs, Md. *Mothproofing.*
'13. BILSING, S. W., College Station, Texas. (F. '41). *Cerambycidae.*
Ch. BIRD, HENRY, 600 Milton Road, Rye, N. Y. (F. '30). *Noctuidae, Papaipema.*
'24. BISHOP, SHERMAN C., Department of Biology, University of Rochester, Rochester, N. Y. (F. '43). *Arachnida.*
Ch. BISHOPP, F. C., Bureau of Entomology and Plant Quarantine, Washington 25 D. C. (F. '28). *Ixodoidea, Siphonaptera, Anoplura.*
'25. Bissell, Theodore L., Department of Entomology, University of Maryland, College Park, Md. *Aphididae, Curculionidae.*
'37. Blackburn, Norris D., Department of Zoology and Entomology, Pennsylvania State College, State College, Pa. *Chrysomelidae.*
'32. BLANTON, FRANKLIN S., 3723 Holmes Lane, Building 504, Parkfairfax, Alexandria, Va. (F. '46). *Trypetidae, Otitidae.*
'30. Blauvelt, Helen Hayden, c/o William Savey, Lake Road, Ithaca, N. Y.
'28. Blauvelt, William E., Comstock Hall, Cornell University, Ithaca, N. Y.
'29. BOESEL, M. W., R. R. #2, Oxford, Ohio. (F. '43). *Heleidae, Tendipedidae (Chironomidae).*
'44. Bohart, George Edward, 775 E. Center St., Logan, Utah.
'37. BOHART, RICHARD M., Division of Entomology, College of Agriculture, Davis, Calif. (F. '47). *Strepsiptera, Vespidae.*
'46. Bonhag, Philip F., Department of Entomology, Comstock Hall, Cornell University, Ithaca, N. Y. *Diptera.*
'28. BORROR, DONALD J., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio. (F. '43). *Odonata.*
'46. Boudreaux, H. Bruce, Department of Zoology, Louisiana State University, Baton Rouge 3, La. *Aphididae.*
'14. BOVING, ADAM G., 221 Rock Creek Church Road, Washington 11, D. C. (F. '29, H. F. '41). *Coleopterous Larvae.*
'33. Boyce, A. M., Citrus Experiment Station, Riverside, Calif.
Ch. BRADLEY, J. C., Cornell University, Ithaca, N. Y. (F. '14). *Campsomeris, Vespidae, Scoliidae.*
'19. BRADLEY, G. H., Box 654, New Smyrna Beach, Fla. (F. '41). *Diptera, Culicidae.*
'37. Bradley, William G., 2256 Collingwood Ave., Toledo, Ohio. *Parasitic Hymenoptera.*
'23. Branch, Hazel E., University of Wichita, Wichita 6, Kans. *Chironomidae Larvae.*
'25. Brandhorst, Carl T., 106 Lincoln St., Seward, Neb. *Wasps.*
Ch. BRAUN, ANNETTE F., R. R. #13, Box 41C, Cincinnati 30, Ohio. (F. '24). *Microlepidoptera, Trichoptera.*
'26. BREAKY, E. P., Western Washington Experiment Station, Puyallup, Wash. (F. '43). *Cicadellidae.*

'37. Breland, Osmond P., Department of Zoology, University of Texas, Austin, Texas. *Chalcidoidea, Culicidae.*
'29. Brindley, T. A., 822 East Eighth St., Moscow, Idaho. *Pea Weevil.*
'26. BRITTAIN, W. H., McDonald College, Quebec, P. Q., Canada. (F. '37). *Homoptera.*
'20. BROMLEY, STANLEY W., Scoffieldtoan Road, Stamford, Conn. (F. '37). *Asilidae.*
'40. Brookman, Bernard, Hooper Foundation, University of California Medical Center, San Francisco 22, Calif. *Diptera, Culicidae.*
'47. Brooks, George T., 736 Missouri St., Lawrence, Kans.
'39. Brower, Auburn E., 5 Hospital St., Augusta, Me. *Lepidoptera, Catocala.*
'33. BROWN, F. MARTIN, Fountain Valley School, Colorado Springs, Colo. (F. '44). *Pieridae of the Americas.*
'42. Brown, John H., Administration Building, Department of Public Health, Edmonton, Alberta, Canada.
'26. BROWN, W. J., Entomological Branch, Department of Agriculture, Ottawa, Canada. (F. '40). *Coleoptera.*
'47. Bruce, Willis N., 128 Natural Resources Bldg., Urbana, Ill.
Ch. BRUES, C. T., Biological Laboratory, Harvard University, Cambridge, Mass. (F. '14, H. F. '46). *Hymenoptera.*
'30. BRUNER, S. C., Estacion Agronomica, Santiago de las Vegas, Havana, Cuba. (F. '37). *Homoptera, Hemiptera of Cuba.*
'27. Brunson, Marvin Howard, Box 150, Moorestown, N. J.
'33. BRYANT, ELIZABETH B., Museum of Comparative Zoology, Cambridge 38, Mass. (F. '43). *Arachnida.*
'30. Bryant, Owen, Steamboat Springs, Colo. *Coccinellidae.*
'38. Bryce, P. I., Entomological Laboratory, Vineland Station, Ontario, Canada. *Fruit Tree Insects.*
'45. Buchanan, William Dwight, 522 Remington St., Fort Collins, Colo.
'47. Bucher, Gordon E., 464 Spadina Road, Apt. 2, Toronto, Ontario, Canada. *Morphology, Physiology, Biological Control.*
'27. Buckell, E. R., Field Crop Insect Laboratory, P. O. Building, Kamloops, British Columbia, Canada. *Orthoptera, Odonata.*
Ch. *BUENO, J. R. DE LA TORRE, 925 East Sixth St., Tucson, Ariz. (F. '28). *Aquatic Hemiptera, Heteroptera.*
'31. Bugbee, Robert E., Department of Biology, Allegheny College, Meadville, Pa. *Chalcidoidea.*
'38. Bunn, Ralph W., 5615 Oakmont Ave., Bethesda 14, Md. *Fulgoridae, Curculionidae.*
'45. Buren, William F., Assistant Sanitarian (R), U. S. Public Health Service, P. O. Drawer 1246, Miami Beach, Fla.
Ch. BURGESS, A. F., 24 Franklin St., Greenfield, Mass. (F. '17). *Carabidae, Lepidoptera.*
'35. BURKS, B. D., Illinois Natural History Survey, Urbana, Ill. (F. '44). *Chalcididae.*
'27. *Burrell, Robert W., P. O. Box 1291, Yakima, Wash.
'29. Bushey, Clinton J., Taylor University, Upland, Ind. *Curculio.*
'35. Bussart, J. Everett, 215 West Harrison St., Wheaton, Ill. *Tachinid Biology.*
'30. BUTT, F. H., Cornell University, Ithaca, N. Y. (F. '40). *Morphology, Embryology.*
'20. Buys, John L., Department of Biology, St. Lawrence University, Canton, N. Y. *Homoptera, Cicadellidae.*
'36. Buzicky, Albert W., 512 Montrose Lane, St. Paul 5, Minn. *Chyphotes.*
'46. Byars, L. Freeland, P. O. Box 1595, Nogales, Ariz. *Ecology of Ants.*
'24. BYERS, C. FRANCIS, Department of Biology, University of Florida, Gainesville, Fla. (F. '41). *Odonata.*

C

'35. *CALDWELL, JOHN S., 535 South Court St., Circleville, Ohio. (F. '46). *Fulgoridae, Psyllidae.*
'43. Callan, E. McC., Imperial College of Tropical Agriculture, St. Augustine, Trinidad, Brit. W. Indies. *Hymenoptera.*
Ch. CALVERT, PHILIP P., P. O. Box 14, Cheyney, Pa. (F. '07, H. F. '39). *Odonata.*

'46. Campbell, D. K., Box 308, Vernon, British Columbia, Canada. *Forest Entomology.*
'28. CAMPBELL, FRANK LESLIE, The Scientific Monthly, Smithsonian Institution Building, Washington 25, D. C. (F. '34). *Toxicology.*
'13. CAMPBELL, ROY E., 1208 East Main, Alhambra, Calif. (F. '41).
'14. *Capp, S. B., Box 2054, Philadelphia, Pa.
'40. Capps, Hahn W., Division of Insect Identification, U. S. National Museum, Washington 25, D. C. *Geometridae.*
'33. CARPENTER, F. M., Museum of Comparative Zoology, Harvard University, Cambridge, Mass. (F. '38). *Mecoptera, Neuroptera.*
'26. Carpentier, Fritz, Institute of Ed. Van Veneden, 10 Rue Vivegnis, Liege, Belgium. *Morphology.*
'31. Carruth, Laurence A., Division of Entomology, New York Agricultural Experiment Station, Geneva, N. Y. *Meloidae.*
'22. CARTER, WALTER, P. O. Box 3166, Honolulu, Hawaii. (F. '38). *Insect Transmission of Plant Diseases.*
'26. CARTWRIGHT, O. L., Department of Entomology, Clemson College, Clemson, S. C. (F. '41). *Scarabaeidae.*
'26. Cartwright, William B., Box 495, Lafayette, Ind. *Hessian Fly.*
'45. Castillo, Robert Levi, P. O. Box 759, Guayaquil, Ecuador, South America. *Culicidae.*
'46. Cazier, Mont A., American Museum of Natural History, Central Park W. at 79th, New York 24, N. Y.
'47. Chadwick, Leigh E., Medical Division, Army Chemical Center, Edgewood Arsenal, Md. *Insect Physiology.*
'22. CHAMBERLAIN, JOSEPH C., P. O. Box 278, Forest Grove, Ore. (F. '38). *Chelonethida, Arachnida.*
Ch. CHAMBERLIN, R. V., University of Utah, Salt Lake City, Utah. (Fig. 17). *Myriapoda, Arachnida.*
'18. Chambers, Ernest L., Room 424 Northeast, State Capitol, Madison, Wis.
'14. Champion, H. G., Department of Forestry, Imperial Forestry Institute, University of Oxford, Oxford, England. *Coleoptera.*
'18. Chapin, E. A., U. S. National Museum, Division of Insects, Washington 25, D. C.
'15. Chapman, James W., Silliman Institute, Dumaguete, Philippine Islands. *Ants of P. I.*
'41. Chickering, A. M., 206 South Mingo St., Albion, Mich. *Arachnida.*
'13. Childs, Leroy, Hood River Branch Experiment Station, Hood River, Ore. *Apple and Pear Insects.*
'30. Christenson, L. D., Bureau of Entomology and Plant Quarantine, P. O. Box 1066, Riverside, Calif. *Aptera, Myriapoda.*
'47. Christian, Paul J., 1332 Vermont St., Lawrence, Kans.
'27. Clagg, Charles F., 820 Fifteenth St., C.H.A. #3, Honolulu, T. Hawaii. *Mecoptera, Hemiptera.*
'22. Clark, Charles, 2 Mortimer Drive, Old Greenwich, Conn. *Odonata, Ichneumonidae.*
'14. CLAUSEN, CURTIS P., Bureau of Entomology and Plant Quarantine, Washington, D. C. (F. '37). *Insect Parasites.*
'47. Coher, Edward I., 12 Harvard Terrace, Allston 34, Mass.
'39. COLCORD, MABEL, 2520 Fourteenth St., N. W., Washington 9, D. C. (F. '43). *Bibliography.*
'28. COLE, ARTHUR C., JR., Department of Zoology, University of Tennessee, Knoxville, Tenn. (F. '43). *Formicidae.*
'47. Cole, Elsie Louise, King Hall, University of Wisconsin, Madison 6, Wis.
'16. COLE, F. R., P. O. Box #6, Redlands, Calif. (F. '38). *Diptera, Hymenoptera.*
'29. Collins, Donald L., 20 Circle Lane, Albany 3, N. Y. *Coleoptera.*
'21. Compton, Charles C., 513 South Pine St., Champaign, Ill. *Greenhouse and Truck Insects.*
'29. Conklin, J. G., Department of Entomology, University of New Hampshire, Durham, N. H. *Coccinellidae.*
'35. Connell, Walter A., Department of Entomology, University of Delaware, Newark, Del. *Diptera.*
'46. Connin, Richard V., 515 Meyers St., Toledo 9, Ohio.
'44. Conroy, John H., 138 Magnolia St., Westbury, Long Island, N. Y.

'47. Cook, Carl, Crailhope, Kentucky. *Odonata, Papilionidae.*
Ch. Cook, Mel T., 255 Barnard Road, Larchmont, N. Y. *Entomogenous Fungi.*
'19. Cook, William C., 219 Newell St., Walla Walla, Wash. (F. '38). *Noctuidae.*
'10. Cooley, R. A., U. S. Public Health Service, Hamilton, Mont. (F. '24). *Ixodidae, Ixodiphiginae.*
'36. Cooper, James Furman, University Experiment Farm, Kearneysville, W. Va. *Fruit Insects.*
'47. Cooper, Murray I., Department of Entomology, University of Illinois, Urbana, Ill.
'39. Cope, Oliver B., North Rotunda, Museum Building, Stanford University, Calif. *Anoplura, Mallophaga, Diptera.*
'32. Cory, Ernest N., State Entomologist, College Park, Md.
'21. COSTA-LIMA, ANGELO M. DA., Instituto Oswaldo Cruz, Caixa Postal 926, Rio de Janeiro, Brazil. (F. '39, H. F. '43). *Economic Entomology.*
'15. Cotton, Richard T., 343 North Fourteenth St., Manhattan, Kans. (F. '37). *Curculionid Larvae.*
'35. Couture, Philip G., U. S. D. A., Bureau of Entomology and Plant Quarantine, U. S. Quarantine Station, Rosebank, Staten Island 5, N. Y.
'46. Cowan, Frank A., 2201 Schulle St., Austin, Texas. *Biology Muscoids.*
'46. Cox, Sam M., 127 North Tenth Ave. East, Duluth 5, Minn.
'11. *Crampton, G. C., 86 Pleasant St., Amherst, Mass. (F. '17). *Morphology.*
'39. Crandall, Robert H., Ghost Ranch Lodge, Box 640, Tucson, Ariz. *Hymenoptera.*
'33. Creighton, John T., University of Florida, Gainesville, Fla. *Economic Entomology.*
Ch. Cresson, E. T., Jr., 11 Amherst Ave., Swarthmore, Pa. (F. '24). *Ephydridae, Micropezidae.*
'38. Crowell, H. H., Department of Entomology, Oregon State College, Corvallis, Ore. *Physiology.*
'15. Curran, C. H., American Museum of Natural History, 77th Street and Central Park W., New York, N. Y. (F. '34). *Diptera.*
'43. Curry, John F., P. O. Box 401, c/o California Department of Agriculture, San Pedro, Calif.
'42. Curtis, William E., 311 Dryden Road, Ithaca, N. Y.
'43. Cutkomp, Laurence K., Division of Entomology, University Farm, St. Paul 1, Minn. *Physiology.*
'21. Cutright, Clifford R., Agricultural Experiment Station, Wooster, Ohio. *Aphidae.*

D

'35. *Daggy, Richard H., Arabian American Oil Company, Dhahran, Saudi Arabia. *Ephemeroptera.*
'42. Dailey, Ervin F., 825 East 78th St., Seattle 5, Wash. *Myriapoda.*
'42. Dalmot, Herbert T., 247 Audubon Ave., New York 33, N. Y.
'47. de Locha, Newton Banks, Bom-fim, 335, Olinda, Pernambuco, Brazil.
'43. Dambach, Charles A., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio.
'47. Dampf, Alfonso Tenson, Apartado 2801, Mexico, D. F., Mexico.
'44. d'Andretta, Carlos, Jr., Escola Paulista de Medicina Rua Botucatai 760, Sao Paulo, Brazil. *Taxonomy, Simuliidae.*
'25. Darlington, P. J., Jr., Museum of Comparative Zoology, Cambridge, Mass. (F. '38). *Adephaga, Dryopidae.*
'30. Davidson, Ralph H., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio. (F. '43). *Cicadellidae.*
'43. Davidson, Thomas R., Dominion Laboratory of Plant Pathology, University of Alberta, Edmonton, Alberta, Canada. *Aphidae.*
'22. Davis, Edgar W., Box 218, Union Gap, Wash. *Cicadellidae.*
Ch. Davis, J. J., Purdue University, Lafayette, Ind. (F. '17). *Aphididae, Lachnosterna.*
'13. Dean, George A., Department of Entomology, Kansas State College, Manhattan, Kansas. (F. '17). *Economic Entomology.*
'33. Dean, Ralph W., Cottage Road, Poughkeepsie, N. Y. *Rhynchophora.*
'36. Dearolf, Kenneth, Chief Curator, Pennsylvania State Museum, Harrisburg, Pa. *Cave Insects.*

'25. DEAY, Howard O., Department of Entomology, Purdue University, Lafayette, Ind. (F. '46). *Coreidae, Tenagobia, Micronecta.*
'38. DeBach, Paul H., University of California, Citrus Experiment Station, Riverside, Calif. *Chalcidoidea.*
'24. Decker, George C., Illinois Natural History Survey, Urbana, Ill. *Stalk Borers, Crambus.*
'24. DeCoursey, R. M., University of Connecticut, Storrs, Conn. *Hemiptera.*
'29. DeLeon, Donald, Box 244, Sta. G, Columbus 7, Ohio. *Scolytidae.*
'14. DELONG, D. M., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio. (F.'30). *Cicadellidae.*
'36. Del Ponte, Edwardo, Instituto Bacteriologico, Calle Velez Sarsfield 563, Dept. Nacional de Hygiene, Buenos Ayres, Argentina. *Parasitic Insects.*
'34. *DENNING, DONALD G., Department of Entomology, University of Wyoming, Laramie, Wyo. (F. '43). *Trichoptera, Corethrinae.*
'34. *Deonier, C. C., Box 3391, Orlando, Fla. *Muscidae.*
'46. Dethier, V. G., Department of Biology, The Johns Hopkins University, Baltimore 18, Md. *Insect Physiology.*
'44. Detjen, Gustav H. H., 303 West 42nd St., New York 18, N. Y.
'27. Dicke, Ferdinand F., Box 576 M. O., Toledo, Ohio. *Harmolita Parasites.*
'39. Dickson, Robert C., Department of Entomology, Citrus Experiment Station, Riverside, Calif. *Aphididae, Coccidae.*
'22. DIETRICH, HENRY, Comstock Hall, Cornell University, Ithaca, N. Y. (F. '43). *Coleoptera.*
'35. Dillon, Lawrence S., Reading Public Museum and Art Gallery, Reading, Pa. *Cerambycidae.*
'24. Dills, L. E., Department of Zoology and Entomology, Pennsylvania State College, State College, Pa.
'26. Dirks, C. O., 32 Coburn Hall, University of Maine, Orono, Me. *Biology of Lepidoptera.*
'31. *Ditman, L. P., University of Maryland, College Park, Md. *Ecology.*
'27. *Doak, K. D., Route A, Crown Point, Ind. *Gelechiidae.*
'36. *Dodge, Harold R., Box 436, Route 3, Montgomery, Ala. *Scolytidae.*
'22. DOERING, KATHLEEN C., Department of Entomology, University of Kansas, Lawrence, Kans. (F. '35). *Cercopidae, Fulgoridae.*
'41. Dorsey, Carl K., 437 Woodlawn Avenue, Webster Groves, Mo. *Immature Coleoptera.*
'37. Dorst, Lt. Col. Howard E., Box 109, U. S. A. C. Campus, Logan, Utah. *Cicadellidae.*
'22. Doucette, Charles F., Box 458, Sumner, Wash. *Ornamental Insects.*
'23. Douglass, J. R., Box 1100, Twin Falls, Idaho.
'45. Doutt, Richard L., 1050 San Pablo Ave., Albany 6, Calif. *Mymaridae.*
'28. DOVE, W. E., Defense Hiway, Gambrills, Md. (F. '40). *Parasites.*
'31. Dow, Richard, Box 135, Berkeley, Calif. *Sphecoid Wasps.*
'22. DOWDEN, PHILIP B., 335 Prospect St., New Haven 11, Conn. (F. '46). *Parasitic Hymenoptera.*
'22. DRAKE, CARL J., Iowa State College, Ames, Iowa. (F. '31). *Tingitidae.*
'37. Dreisbach, Robert R., 301 Helen St., Midland, Mich. *Hymenoptera.*
'31. Driggers, Byrley F., Agricultural Experiment Station, New Brunswick, N. J. *Economic Entomology.*
'38. Drolet, Marcel, 95 Stefoy Road, Quebec, Quebec, Canada. *Cerambycidae.*
'45. DuChanois, F. Robert, Entomological Service & Supply Co., Zionsville, Ind. *Formicidae, Muscoidea.*
'26. Dunavan, David, 116 North Clemson Ave., Clemson, S. C. *Haliplidae.*
'23. DUNCAN, CARL D., Box 4, Stanford University, Calif. (F. '14). *Vespidae, Bembicidae.*
'28. Dunnam, E. W., Box 8, Leland, Miss. *Cotton Resistance to Insects.*
'14. Dusham, E. H., 607 North Burrowes St., State College, Pa. *Coleoptera.*
'43. Dybas, Henry S., Division of Insects, Chicago Natural History Museum, Chicago 5, Ill. *Ptiliidae, Nanosellinae.*

E

Ch. Easton, Norman S., 458 High St., Fall River, Mass. *Coleoptera.*
'44. Eaton, Charles B., Forest Insect Division, Bureau of Entomology and Plant Quarantine, Agricultural Research Center, Beltsville, Md. *Forest Insects.*

'46. Eberlein, George, West Concord, Mass.
'31. ECKERT, J. E., University Farm, University of California, Davis, Calif. (F. '43). *Beekeeping.*
'36. Eddy, C. Brayton, New York Zoological Society, N. Y. Zoological Park, New York 60, N. Y.
'23. EDDY, C. O., Niagara Sprayer and Chemical Co., Middleport, N. Y. (F. '31).
'40. Elishewitz, Harold, 953 Goodrich Ave., St. Paul 5, Minn. *Ixodoidea.*
'24. Elmore, J. C., 1208 East Main, Alhambra, Calif. *Truck Crop Insects.*
'19. EMERSON, ALFRED E., Department of Zoology, University of Chicago, Chicago, Ill. (F. '37). *Isoptera, Termitophiles.*
'38. Emerson, K. C., Entomology Department, Oklahoma A. & M. College, Stillwater, Okla. *Mallophaga, Anoplura.*
'25. Enders, Howard E., 249 Littleton St., West Lafayette, Ind. *Mallophaga.*
Epstein, Erwin, 6302 Dieterle Crescent, Rego Park, Long Island, N. Y.
'43. Esselbaugh, Charles O., 212 Columbia, Pullman, Wash. *Pentatomidae, Scutelleridae.*
'10. ESSIG, E. O., University of California, Berkeley, Calif. (F. '26). *Aphididae, Coccidae.*
'29. Evans, J. Harwood, Oshkosh High School, Oshkosh, Wis. *Phymatidae.*
'30. Everly, Ray T., 4299 N. High St., Columbus 2, Ohio. *Carabidae.*
'10. EWING, HENRY E., U. S. National Museum, Washington, C. D. (F. '28). *Acarina.*
'18. EYER, JOHN R., State College, N. Mex. (F. '38). *Cicadellidae, Chermidae.*

F

'32. FAIRCHILD, GRAHAM BELL, 651 Ancon, 62, Panama. (F. '43). *Culicidae, Tabanidae.*
'40. Fallis, A. Murray, Ontario Research Foundation, 43 Queens Park, Toronto, Ontario, Canada. *Insect Parasites.*
'35. Falls, Olive, 5535 Dorchester Ave., Chicago, Ill. *Termite Biology.*.
'30. Farquhar, Donald W., 185 Claremont Ave., New York 27, N. Y. *Lepidoptera of New England.*
'17. Fattig, P. W., Box 788, Emory University, Ga.
'45. Faure, Gabriel O., Dept. Sanidad Vegetal, Casilla 4647, Santiago, Chile, South America.
'34. Fay, Richard William, 417 East 53rd St., Savannah, Ga. *Insect Physiology.*
'36. Fenton, Alfred S., 1002 Second National Bank Building, Houston 2, Tex.
Ch. FERNALD, H. T., 1128 Oxford Road, Winter Park, Fla. (F. '14, H. F. '37). *Sphecidae.*
'47. Fernandez, Francisco J., Ingeniero Agronomo, Calle Oeste, Escuela de Medicina No. 16-A, Caracas, D. F., Venezuela.
'14. FERRIS, G. F., Natural History Museum, Stanford University, Calif. (F. '34). *Coccidae, Mallophaga, Anoplura, Diptera.*
'35. FIELD, WILLIAM D., Bureau of Entomology and Plant Quarantine, Washington, D. C. (F. '46). *Arctiidae, Lycaenidae.*
Ch. Field, William L. W., 75 Vose's Lane, Milton 87, Mass.
'31. Filmer, Robert Sterling, Rutgers University, New Brunswick, N. J. *Hymenoptera.*
'35. Fisher, Elizabeth G., 20 Blythewood Road, Baltimore 10, Md. *Odonata, Mycetophilidae.*
'36. Fisk, Frank W., Division of Entomology, University of Minnesota, University Farm, St. Paul 1, Minn. *Culicidae.*
'30. FLANDERS, STANLEY E., Citrus Experiment Station, Riverside, Calif. (F. '37). *Biology of Chalcidoidea.*
'22. Fletcher, Frank C., Room 301, 100 Gibbs St., Rochester 1, N. Y. *Colooptera.*
'31. Fletcher, Fred W., Department of Biochemistry, Dow Chemical Company, Midland, Mich. *Insecticides.*
'43. Flock, Robert A., Citrus Experiment Station, Riverside, Calif.
'24. FLUKE, C. L., King Hall, University of Wisconsin, Madison 6, Wis. (F. '35). *Syrphidae.*
'42. Fluno, John A., 244 Sylvan Blvd., Winter Park, Fla.
'45. Fontaine, Russel E., Surgeons' Sect., Hq. XXIV Corps, APO 235, c/o P. M., San Francisco, Calif.
'38. Forbes, James, 2986 Marion Ave., New York 58, N. Y. *Formicidae.*

'08. *FORBES, WILLIAM T. M., Cornell University, Ithaca, N. Y. (F. '30). *Lepidoptera, Neuropteroids.*
'30. Foster, Charles E., Colgate University, Hamilton, N. Y. *Coccidae.*
'46. Fox, Irving, School of Tropical Medicine, San Juan, Puerto Rico. *Ectoparasites, Culicoides.*
'11. FRACKER, S. B., Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture, Washington, D. C. (F. '34). *Coreidae.*
'47. Franclemont, John G., Division of Insects, U. S. National Museum, Washington 25, D. C.
'23. FREEBORN, STANLEY B., 101 Giannini Hall, University of California, Berkeley, Calif. (F. '38. *Culicidae.*
'22. FRIEND, ROGER B., Agricultural Experiment Station, 153 Huntington St., New Haven, Conn. (F. '38). *Diptera.*
'44. Frizzell, Harriet Exline, Department of Zoology, University of Texas, Austin 12, Tex. *Araneida.*
'40. Froeschner, Richard C., 5102a Lotus Ave., St. Louis 13, Mo. *Hemiptera.*
'40. Fronk, W. Don, Tidewater Field Station, Holland, Va.
Ch. FROST, C. A., 67 Henry St., Framingham, Mass. (F. '44). *Coleoptera.*
'41. Frost, Florence M., 1376 Shattuck Ave., Berkeley 7, Calif. *Diptera.*
'14. FROST, STUART W., 465 East Foster Ave., State College, Pa. (F. '35). *Agromyzidae, Hispinae.*
Ch. FULLAWAY, D. T., Agricultural Board, Box 3319, Honolulu, Hawaii. (F. '40). *Parasitic Hymenoptera, Braconidae.*
'16. FULTON, B. B., State College, Raleigh, N. C. (F. '32). *Orthoptera.*
'11. FUNKHOUSER, WILLIAM D., University of Kentucky, Lexington, Ky. (F. '20). *Membracidae.*
'40. Furniss, Robert L., 445, U. S. Court House, Portland, Ore. *Forest Entomology.*

G

Ch. GAHAN, A. B., U. S. National Museum, Washington, D. C. (F. '28). *Chalcidoidea.*
'16. GAIGE, F. M., 1211 Ferdon Road, Ann Arbor, Mich. (F. '38). *Formicidae.*
'26. Galindo, Pedro, Apartado 1443, Panama, Republica de Panama.
'47. Gammons, John Gray, 2911 S. Dinwiddie St., Apt. C-1, Fairlington, Arlington, Va. *Culicidae, Tabanidae.*
'22. Garlick, W. G. P., Vineland Station, Ontario, Canada. *Tenthrediniodea.*
'14. GARMAN, PHILIP, Agricultural Experiment Station, New Haven, Conn. (F. '38). *Odonata, Acarina.*
'46. Gaul, Albro, 401 Washington Ave., Brooklyn 5, N. Y. *Vespinae, Polistinae.*
'39. Gauthier, Georges, Entomologiste, Ministere de l'Agriculture, Quebec, Canada.
'45. Gelfand, Henry M., 6005 University Ave., Chicago 37, Ill. *Mosquitoes and Medical Entomology.*
'16. GENTNER, LOUIS G., 22 Groveland Ave., Medford, Ore. (F. '44). *Halticinae.*
'45. Gerberich, John B., Department of Zoology, University of Minnesota, Duluth Branch, Duluth 5, Minn. *Medical Entomology and Immature Insects.*
Ch. GERHARD, WILLIAM J., Chicago Museum of Natural History, Chicago 5, Ill. (F. '43). *Hemiptera.*
'44. Gerlach, Charles F., Michigan Chemical Corporation, St. Louis, Mich.
'22. Gerry, Bertram I., Box 28, Wellesley Hills 82, Mass. *Culicidae and Chironomidae.*
'32. GERTSCH, WILLIS J., American Museum of Natural History, 79th Street and Central Park West, New York, N. Y. (F. '40). *Arachnida.*
Ch. GIBSON, ARTHUR, Apt. 6, 30 Cooper St., Ottawa, Ontario, Canada. (F. '17).
'14. Gibson, E. H., Trinity Episcopal Church, Galveston, Tex. *Hemiptera.*
'44. Gibson, W. W., LeMoyne College, Memphis, Tenn.
'21. Gilmer, Paul M., Coastal Plains Experiment Station, Tifton, Ga. *Cotton Insects.*
'11. Glasgow, Hugh, Experiment Station, Geneva, N. Y.
'11. Glasgow, Robert D., State Education Building, Albany, N. Y. *Forest Insects.*
'39. Glick, Perry A., Box 1218, Waco, Texas. *Cotton Insects, Lepidoptera.*

'33. Glover, L. C., Box 486, T. Hall, Durham, N. H. *Carabidae, Cerambycidae.*
'30. Glover, Louise Haas, Shell Agricultural Laboratory, Modesto, Calif. *Carabidae.*
'45. Goelbert, Raymond, 6421 65th Place, Middle Village, N. Y.
'46. Goldberg, Alma Rutledge, 621 St. Johns Road, Baltimore 10, Md.
'30. GOOD, NEWELL E., U. S. Public Health Service, 620 S. 3rd St., Louisville 2, Ky. (F. '43). *Siphonaptera, Culicidae, Stored Grain Beetles.*
'44. Goodwin, M. H., Jr., Assistant Sanitarian, U. S. P. H. S., 605 Volunteer Bldg., Atlanta 3, Ga.
'36. Gouck, Harry K., 1530 Grove Terrace, Winter Park, Fla. *Plecoptera.*
'31. Gould, George E., Purdue University, Lafayette, Ind. *Rhagovelia, Semi-aquatic Hemiptera.*
'39. Graham, Lewis T., Southwestern Station, Box 403, Lafayette, La. *Membracidae.*
'17. GRAHAM, SAMUEL A., University of Michigan, Ann Arbor, Mich. (F. '32). *Forest Insects.*
'22. GRANOVSKY, A. A., Division of Entomology, University Farm, St. Paul 1, Minn. (F. '35). *Aphiidae, Phyllophaga.*
'25. Grant, U. S., IV, Natural History Museum, Balboa Park, San Diego, Calif.
'17. Green, J. W., R. D. #2, Easton, Pa. *Cantharidae, Lampyridae.*
'14. GREENE, CHARLES T., 4805 Guilford Road, College Park, Md. (F. '46). *Diptera.*
'43. Gregg, Robert E., Department of Biology, University of Colorado, Boulder, Colo.
'36. *GRESSITT, J. LINSLEY, Natural History Survey & Museum, Lingnam University, Canton, China. (F. '43). *Coleoptera.*
'34. GRIFFITH, MELVIN E., Department of Zoological Sciences, University of Oklahoma, Norman, Okla. (F. '47). *Alconeura, Collembola, Culicidae.*
'42. Griffiths, James T., Jr., Citrus Experiment Station, Lake Alfred, Fla.
'33. *GURNEY, ASHLEY B., Division of Insects, U. S. National Museum, Washington, D. C. (F. '43). *Orthoptera, Zoroptera, Corrodentia.*

H

'23. Hadley, C. H., Bureau of Entomology and Plant Quarantine, Moorestown, N. J. *Japanese Beetle.*
'24. HAEUSSLER, GILBERT J., Bureau of Entomology and Plant Quarantine, Washington 25, D. C. (F. '41). *Ichneumonidae, Braconidae.*
'14. HAGEN, HAROLD R., Department of Biology, College of the City of New York, 139th and Convent Ave., New York 31, N. Y. (F. '38). *Embryology.*
'45. Hagen, Ellsworth, 2647 22nd Ave., Oakland 6, Calif.
'47. Hagen, Kenneth S., Division of Biological Control, University of California, Gill Tract, 1050 San Pablo Ave., Albany 6, Calif. *Notoxus, Amblyderus and Mecynotarsus.*
'25. HALL, DAVID G., 593 Arlington Village, Arlington, Va. (F. '41). *Sarcophagidae, Diptera.*
'41. Hambleton, Edson J., Office of Foreign Agricultural Relations, U. S. Department of Agriculture, Washington 25, D. C. *Tingitidae* (Neotropical).
'47. Hamed Ali, Mir, Division of Entomology, University Farm, St. Paul, Minn.
'22. Hamner, A. L., Box 223, State College, Miss. *Aphididae, Phylloxera.*
'46. *Hanan, Blake B., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio.
'44. Hansens, Elton J., New Jersey Agricultural Experiment Station, New Brunswick, N. J.
'39. Hanson, John F., 47 Mt. Pleasant St., Amherst, Mass. *Plecoptera.*
'39. Harden, Philip H., Department of Zoology, University of Minnesota, Minneapolis, Minn. *Plecoptera.*
'37. Hardy, D. Elmo, Department of Zoology and Entomology, Iowa State College, Ames, Iowa. *Pipunculidae, Bibionidae, Dorilaidae.*
'36. Harmston, Fred Carl, 117 East 27th South, Salt Lake City, Utah. *Dolichopodidae.*
'07. *HARNED, R. W., Bureau of Entomology and Plant Quarantine, Washington 25, D. C. (F.'27).
'33. Harper, Lawrence C., R. R. #1, Lafayette, N. Y. *Diptera.*

'29. Harries, F. H., 151 West Eleventh Ave., Columbus, Ohio. *Ecology, Physiology.*
'23. Harris, Halbert M., Department of Zoology, Iowa State College, Ames, Iowa. (F. '37). *Hemiptera.*
'44. Harston, George B., Wyoming State Entomologist, P. O. Box 785, Powell, Wyo.
'47. Harpster, Hilda T., Woman's College of University of North Carolina, Greensboro, N. C.
'42. Hart, Thomas A., 5556 Kimbark Ave., Chicago, Ill.
'39. Hartnack, Hugo, 324 North Fourth St., Tacoma, Wash.
'21. Hartzell, Albert, Boyce Thompson Institute, 1086 North Broadway, Yonkers 3, N. Y. *Cicadellidae.*
'07. Hartzell, F. Z., Agricultural Experiment Station, Geneva, N. Y. *Coleoptera.*
'46. Hasbrouck, Frank, 303 Harker Hall, University of Illinois, Urbana, Ill.
Ch. Haseman, Leonard, Whitten Hall, Department of Entomology, University of Missouri, Columbia, Mo. *Psychodidae.*
'32. Haskins, Caryl P., Green Acre Lane, Westport, Conn. (F. '44). *Formicidae, Hymenoptera.*
'20. Hatch, Melville H., Department of Zoology, University of Washington, Seattle 5, Wash. (F. '38). *Coleoptera.*
'38. Hathaway, Edward S., Department of Zoology, Tulane University, New Orleans, La. *Ecology of Marsh Insects.*
'32. Haub, James G.. Department of Zoology, Ohio State University, Columbus 10, Ohio. *Physiology.*
'39. Haude, William J., c/o John Powell & Company, One Park Ave., New York, N. Y. *Culicidae.*
'30. Haug, Gordon W., Kelowna, British Columbia, Canada. *Formicidae.*
'27. Hawkins, J. H., Agricultural Experiment Station, Orono, Me. *Elaterid and Noctuid Larvae.*
'35. Haydak, N. H., Division of Entomology, University Farm, St. Paul 8, Minn. (F. '47). *Honeybee Nutrition.*
'19. Hayes, William P., Entomology Building, University of Illinois, Urbana, Ill. (F. '29). *Larvae.*
'31. Heaton, Robert R., 518 Architects & Builders Building, Indianapolis 4, Ind. *Fulgoridae, Homoptera.*
'32. Henderson, Charles, 803 Forty-third Ave., Gulfport, Miss. *Parasites of Scale Insects.*
'31. Henderson, Lyman S., Bureau of Entomology and Plant Quarantine, Beltsville Research Center, Beltsville, Md. (F. '43). *Curculionidae.*
'29. Hering, Paul E., Department of Biology, Carthage College, Carthage, Ill. *Economic Entomology.*
'25. Herms, William B., 112 Agriculture Hall, University of California, Berkeley, Calif. (F. '29). *Medical Entomology.*
Ch. Herrick, Glenn W., 219 Kelvin Place, Ithaca, N. Y. (F. '14). *Thysanoptera, Coccidae.*
'46. Hershberger, Ruth V., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio.
'43. Hertig, Major Marshall, Sn.C., c/o Headquarters P.C.D., APO 834, c/o Postmaster, New Orleans, La.
'28. Hickman, J. R., Normal College, Ypsilanti, Mich. *Haliplidae.*
'46. Hilchey, John Duncan, Comstock Hall, Cornell University, Ithaca, N. Y.
'08. Hilton, William A., 1263 Dartmouth Ave., Claremont, Calif. (F. '39.) *Symphyla, Pauropoda.*
'27. Hinman, E. Harold, Health and Safety Department, Tennessee Valley Authority, Wilson Dam, Ala. (F. '37). *Culicidae.*
'33. Hinton, Howard E., Department of Entomology, British Museum (Natural History), Cromwell Road, London S. W. 7, England. (F. '44). *Dryopidae.*
'47. Hobbs, Kenneth Rollin, Department of Entomology, Oregon State College, Corvallis, Ore.
'27. Hockenyos, George L., 213 East Jefferson St., Springfield, Ill. *Economic Entomology.*
'38. Hodge, Charles 4th, Department of Biology, Temple University, Philadelphia, Pa. *Coleoptera.*
Ch. Hodgkiss, H. E., 147 West Park Ave., State College, Pa. *Eriophyiidae.*

'29. HODSON, A. C., Division of Entomology, University Farm, St. Paul, Minn. (F. '43). *Ecology.*
'44. Hoff, C. Clayton, Department of Biology, University of New Mexico, Albuquerque, New Mexico. *Pseudoscorpions.*
'29. Hoffmann, Clarence H., Box 71, Bowie, Md. *Scarabaeidae, Trichiotinax, Osmoderma.*
'20. HOFFMANN, WILLIAM E., Lingnan University, Canton, China. (F. '39). *Hemiptera.*
'35. Holway, Richard T., 9 Crescent St., Shrewsbury, Mass. *Termites.*
'38. Hoogstraal, Harry, Chicago Natural History Museum, Chicago 5, Ill. *Morphology, Culicidae.*
'34. HORSFALL, WILLIAM R., Department of Entomology, University of Illinois, Urbana, Ill. (F. '43). *Bionomics, Culicidae.*
'34. HOSKINS, W. M., 112 Agriculture Hall, University of California, Berkeley, Calif. (F. '47). *Physiology.*
'24. Hough, W. S., Winchester, Va. *Apple Insects.*
'44. Hovanitz, William, University of Michigan, Laboratory of Vertebrate Biology, Ann Arbor, Mich. *Lepidoptera, Genetics, Physiology.*
'39. Hovey, Charles L., Box 728, Eastern States Farmers Exchange, Hedrick Building, West Springfield, Me. *Aphiidae.*
Ch. HOWARD, L. O., Bureau of Entomology and Plant Quarantine, Washington, D. C. (F. '07, H. F. '24). *Chalcidoidea.*
'14. HOWARD, NEALE F., 151 West Eleventh Ave., Columbus, Ohio. (F. '44). *Mexican Bean Beetle, Truck Crop Insects.*
'39. Howland, A. F., 1208 East Main St., Alhambra, Calif. *Tomato Insects.*
'23. HUBBELL, THEODORE H., Museum of Zoology, University of Michigan, Ann Arbor, Mich. (F. '39). *Orthoptera.*
'20. HUCKETT, H. C., Long Island Vegetable Research Farm, Riverhead, Long Island, N. Y. (F. '38). *Muscidae.*
'44. Huffaker, Carl B., 1050 San Pablo Ave., Albany 6, Calif. *Mecoptera.*
'39. Hughes, John H., Division of Biological Science, University of Georgia, Athens, Ga. *Chrysomelidae.*
'16. HUNGERFORD, H. B., 323 Snow Hill, University of Kansas, Lawrence, Kans. (F. '27). *Aquatic Hemiptera.*
'43. Hunt, Charles R., Horticulture Branch Experiment Station, Corvallis, Mont. *Collembola.*
'47. Hurd, Paul D., Jr., 112 Agriculture Hall, University of California, Berkeley 4, Calif.
'36. Hurlbut, Herbert S., Naval Medical Research Institute, National Naval Medical Center, Bethesda 14, Md. *Culicidae.*
'38. Hutson, Ray, Department of Entomology, Michigan State College, East Lansing, Mich. *Insecticides.*
'08. HYSLOP, JAMES A., Arsenal, Silver Spring, Md. (F. '35). *Elateridae.*

I

'31. IDE, F. P., Department of Zoology, University of Toronto, Toronto 5, Ontario, Canada. (F. '40). *Ephemeroptera.*
'19. *ILLINGWORTH, J. F., Bishop Museum, Honolulu, Hawaii. (F. '40). *Muscoidea.*
'47. Incho, Harry H., 4512 Mountview Road, Baltimore 29, Md.
'28. Ingram, J. W., Box 387, Houma, La. *Sugarcane Insects.*
'14. ISELY, DWIGHT, Box 3, University Station, Fayetteville, Ark. (F. '34). *Chrysomelidae, Curculionidae.*
'36. ISELY, F. B., 2835 West Gramercy, San Antonio, Tex. (F. '46). *Orthoptera.*
'27. Ives, J. D., Jefferson City, Tenn. *Cave Insects.*
'34. Ivy, Edward E., Box 1218, Waco, Tex.

J

'41. James, Brother Cyprian, Manhattan College, Spuyten Duyvil Parkway, New York 63, N. Y. *Psyllidae.*
'38. James, Freburn L., 1459 East Wilson, Glendale, Calif. *Coleoptera.*
'31. JAMES, MAURICE T., Department of Zoology, State College of Washington, Pullman, Wash. (F. '40). *Stratiomyiidae.*

'30. Janes, Melvin J., 89 Haven Ave., Port Washington, N. Y. *Economic Entomology.*
'35. Jaques, Harry E., 709 North Main, Mount Pleasant, Iowa. *Insect Ecology.*
'30. Jaynes, Harold A., Brooksvale Ave., Mt. Carmel, Conn. *Tiphia of S. A.*
'47. Jenkins, Dale, Army Chemical Center, Edgewood, Maryland.
'41. Jensen, Dilworth D., 112 Agriculture Hall, University of California, Berkeley, Calif. *Psyllidae.*
'15. Jewett, H. H., Agricultural Experiment Station, Lexington, Ky. *Tobacco and Forage Crop Insects.*
Ch. JOHANNSEN, O. A., 203 Parkway, Ithaca, N. Y. (F. '14, H. F. '29). *Diptera.*
'46. Johnson, Donald Ross, Division of Entomology, University Farm, St. Paul 1, Minn.
'25. Johnson, Frank, 420 Lexington Ave., New York 17, N. Y. *Lepidoptera.*
Ch. JONES, FRANK M., 2000 Riverview Ave., Wilmington 47, Del. (F. '46). *Psychidae.*
'47. Jones, Jack Colvard, P. O. Box 803, Auburn, Ala. *Coleoptera.*
'46. Jones, Jack D., Box 92, San Joaquin, Calif. *Cicadidae.*
'39. Jones, J. R. J. Llewellyn, "Arranmore," R. M. D. #1, Cobble Hill, British Columbia, Canada. *Ecology of Lepidoptera Larvae.*
'41. Jones, Joseph W., Department of Zoology, University of Tennessee, Knoxville, Tenn. *Culicidae, Ants (Ponera).*
'45. Jones, Sarah E., Department of Biology, Box 3716, Texas State College for Women, Denton, Tex. *Arachnida.*
'45. Joyce, Charles R., U.S.P.H.S., Quarantine, P. O. Box 1410, Honolulu, T. Hawaii. *Culicidae, Ixodoidea, Siphonaptera.*
'46. Judd, William W., Department of Zoology, McMaster University, Hamilton, Ontario, Canada.
'40. Just, Theodore K., Chief Curator in Botany, Chicago Natural History Museum, Chicago 5, Ill.

K

'42. Kadner, Carl G., Loyola University, Los Angeles, Calif. *Hippoboscidae, Culicidae.*
'34. Kagy, J. Franklin, c/o Dow Chemical Company, P. O. Box 245, Seal Beach, Calif. *Insect Toxicology.*
'26. Kamal, Mohammed, c/o A. Moursi, Minister of Agriculture, Parasite Laboratory, Giza, Egypt. *Cotton Insects.*
'34. KEARNS, CLYDE W., Department of Entomology, University of Illinois, Urbana, Ill. (F. '47). *Insecticides.*
'29. Keck, Chester B., Box 2280, Honolulu, T. Hawaii. *Ecology.*
'14. KENNEDY, C. H., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio. (F. '27). *Odonata, Ants.*
Ch. Kincaid, Trevor, University of Washington, Seattle Wash. *Psychodidae, Dytiscidae.*
'47. King, Edwin W., Box 864, V. P. I., Blacksburg, Va. *Scarabaeidae, Cerambycidae.*
'12. KING, J. L., Box 150, Moorestown, N. J. (F. '32). *Biological Control.*
'28. KING, WILLARD V., Box 3391, Orlando, Fla. (F. '38). *Culicidae.*
'18. KINSEY, ALFRED C., Indiana University, Bloomington, Ind. (F. '28). *Cynipidae.*
'38. KLOTS, ALEXANDER B., Department of Biology, The City College of New York, 17 Lexington Ave., New York, N. Y. (F. '47). *Lepidoptera, Pyralididae, Culicidae.*
'45. Knapp, Virgil R., R. R. #1, Box 100, Zionville, Ind. *Aphididae.*
'11. KNIGHT, H. H., Department of Zoology, Iowa State College, Ames, Iowa. (F. '28). *Hemiptera, Miridae.*
'40. Knight, Kenneth L., Naval Medical Research Institute, Naval Medical Center, Bethesda 14, Md. *Geometrid Larvae, Mosquitoes.*
'24. KNOWLTON, GEORGE F., Utah State Agricultural College, Logan, Utah. (F. '43). *Aphididae.*
'34. KNULL, MRS. DOROTHY, 330 East Dunedin Road, Columbus 2, Ohio. (F. '43). *Cicadellidae, Cercopidae.*

'34. KNULL, JOSEF N., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio. (F. '43). *Cleridae, Elateridae, Buprestidae, Cerambycidae.*
'37. Knutson, Herbert C., R. 1, State College, Kingston, R. I. *Phalaenidae, Culicidae.*
'34. Kottke, Mrs. Esther H., 103 Johnson St., Chapel Hill, N. C. *Isoptera, Hymenoptera.*
'17. Kraatz, Walter C., Department of Biology, University of Akron, Akron, Ohio.
'42. Krafchick, Bernard, 578 Greene Ave., Brooklyn, N. Y.
'41. Kramer, Sol, Department of Entomology, University of Illinois, Urbana, Ill.
'45. Krauss, Noel Louis H., Plant Quarantine Inspector, Territory of Hawaii, 2437 Parker Place, Honolulu 5, Hawaii.
'40. Kretzschmar, Gerhard, Office of the State Entomologist, University Farm, St. Paul 1, Minn. *Soybean Insects.*
'34. KROMBEIN, KARL VON VORSE, Division of Insects, U. S. National Museum, Washington 25, D. C. (F. '44). *Aculeate Hymenoptera.*
'41. Kuitert, Louis C., Entomology Department, Kansas State College, Manhattan, Kans. *Nepidae, Gerridae.*
'36. Kulash, Walter M., Department of Zoology and Entomology, North Carolina State College, Raleigh, N. C. *Collembola.*

L

'45. Laffoon, Jean L., 2704 Lincoln Way, Ames, Iowa. *Diptera.*
'46. La Hue, Delmon W., Georgia Coastal Plain Experiment Station, Tifton, Ga.
'46. Laidlaw, Harry H., University of California, Berkeley, Calif.
'28. Lamiman, J. F., California Polytechnic College, San Dimas, Calif. *Acarina.*
'30. LANDIS, B. J., P. O. Box 218, Union Gap, Wash. (F. '40). *Biological Control.*
'42. Lane, John, Instituto de Higiene de Sao Paulo, Caixa Postal 99 B, Sao Paulo, Brazil.
'40. Lange, W. Harry, Jr., Division of Entomology, University of California, Davis, Calif. *Lepidoptera.*
'25. Langford, George S., Department of Entomology, University of Maryland, College Park, Md. *Economic Entomology.*
'46. Lanham, Urless N., Division of Entomology and Parasitology, University of California, Berkeley, Calif.
'17. Langston, James M., State College, Miss. *Phyllophaga.*
'37. LaRivers, Ira, Division of Entomology, University of California, Berkeley 4, Calif. *Odonata, Psychodidae.*
'14. Larrimer, W. H., U.S.D.A., Forest Service, Washington, D. C. *Cicadellidae.*
'38. Larson, N. P., Box 674, Hulmeville, Pa. *Physiology.*
'37. Lassmann, G. W., Independencia #3, Jalapa, Vera Cruz, Mexico. *Culicidae.*
'13. LATHROP, F. H., Agricultural Experiment Station, Orono, Me. (F. '41). *Cicadellidae.*
'40. Latta, Randall, 11 U. S. Courthouse, El Paso, Texas. *Toxicology.*
'23. Lauderdale, J. L. E., P. O. Box 2006, Phoenix, Ariz.
'47. Lawson, Fred A., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio.
'17. LAWSON, PAUL B., 2215 Vermont St., Lawrence, Kans. (F. '31). *Cicadellidae.*
'39. Leech, H. B., Department of Entomology, California Academy of Science, Golden Gate Park, San Francisco 18, Calif. *Coleoptera.*
'12. LEIBY, R. W., Comstock Hall, Cornell University, Ithaca, N. Y. (F. '40). *Embryology.*
'38. Leonard, Justin W., Institute for Fisheries Research, University Museums Annex, Ann Arbor, Mich. *Aquatic Insects.*
'11. LEONARD, MORTIMER D., 2480 Sixteenth Street N. W., Washington, D. C. (F. '46). *Aphididae.*
'45. Lewis, Sue Sparks (Mrs. W. M.), General Delivery, Sta. A, Ames, Iowa. *Formicidae.*
'47. Lienk, Siegfried E., 303 Harker Hall, Urbana, Ill.
'33. Lilly, John H., King Hall, University of Wisconsin, Madison 6, Wis. *Coleophoridae.*
'34. Lindgren, David L., University of California, Citrus Experiment Station, Riverside, Calif. *Toxicology.*

'39. Lindquist, Arthur W., Box 332, Corvallis, Ore. *Chironomidae.*
'46. Lindsay, Capt. Dale R., 218 W. Kelly, Pharr, Texas. *Diptera.*
'17. LINDSEY, A. W., Denison University, Granville, Ohio. (F. '40). *Hesperioidea.*
'33. *LINSLEY, E. GORTON, 112 Agricultural Hall, University of California, Berkeley, Calif. (F. '41). *Cerambycidae, Coleoptera.*
'47. Lipovsky, Louis J., Department of Entomology, University of Kansas, Lawrence, Kans.
'25. LIST, GEORGE M., Agricultural College, Fort Collins, Colo. (F. '32). *Cimicidae.*
'30. Livingstone, E. M., 4425 Bienville Ave., New Orleans, La.
'31. Lloyd, Llewellyn, University of Leeds, London, England.
'19. Lobdell, Mrs. Gladys H., Route 2, Brevard, N. C. *Coccidae.*
'46. Ludwig, Carl E., 33 Lebanon St., Winchester, Mass.
'38. Ludwig, Daniel, Department of Biology, New York University, 181st Street and University Avenue, New York 53, N. Y. *Physiology.*
'13. LUGINBILL, PHILIP, Box 495, Lafayette, Ind. (F. '41). *Phyllophaga.*
'34. Lund, Horace O., Division of Biological Science, University of Georgia, Athens, Ga. *Culicidae.*
'31. Lyle, Clay, Box 1538, State College, Miss. *Crustacea.*
'40. Lyman, F. Earle, U.S.P.H.S., P.H.S. 3472, 412 Hilldale Ave., Decatur, Ga. *Aquatic Insects, Ephemeroptera.*

M

'43. Mackenzie, George P., 1284 Sherwood Road, San Marino 9, Calif. *Coleoptera.*
'40. MacSwain, J. W., 112 Agricultural Hall, Department of Entomology, University of California, Berkeley 4, Calif.
'20. McBride, O. C., Research Center, Beltsville, Md. *Insecticides.*
'43. McCall, George L., 905 Bertrand Ave., Manhattan, Kans. *Chemical Control of Insects.*
'29. McClure, H. Elliott, Box 292, Station A, Bakersfield, Calif. *Ecology.*
'10. McDaniel, Eugenia, Agricultural College, East Lansing, Mich. *Coccidae, Orthoptera.*
'30. McGovran, E. R., Office of Experiment Station, U.S.D.A., Washington, D. C. *Insecticides.*
'11. McINDOO, N. E., 7225 Blair Road, Takoma Park, Washington 12, D. C. (F. '34). *Insect Physiology.*
'32. Madden, A. H., Bureau of Entomology and Plant Quarantine, Box 3391, Orlando, Fla. *Economic Entomology.*
'47. Magner, Marshall, 1700 S. 2nd, St. Louis, Mo.
'43. Maina, Bartholomew A., 10623 Church St., Chicago, Ill. *Bombidae.*
'46. Malkin, Borys, University of Oregon, Department of Anthropology, Eugene, Ore. *Coccinellidae.*
'40. Mangrum, James F., Box 203 F. E., Biology Department, A. & M. College, College Station, Texas. *Acarina.*
'13. *MANN, WILLIAM M., Natural Zoological Park, Washington, D. C. (F.'37). *Formicidae.*
'23. Manter, Jerauld A., Agricultural College, Storrs, Conn. *Economic Entomology.*
'37. Markos, Basil G., 2180 Milvia St., Berkeley, Calif. *Toxicology.*
Ch. MARLATT, C. L., 1521 Sixteenth Street N. W., Washington, D. C. (F. '07, H. F. '41). *Coccidae.*
'25. Martin, Charles H., Department of Entomology, Oregon State College, Corvallis, Ore. *Ecology, Asilidae.*
'43. Martin, Esmond B., 465 East 57th St., New York 22, N. Y.
'34. MARTORELL, LUIS F., Agricultural Experiment Station, P. O. Box 614, Rio Piedras, Puerto Rico. (F. '44). *Sugar Cane, Forest Insects.*
'38. Marvin, Philip H., Hartford Road, Moorestown, N. J. *Biology of Melittobia.*
'30. Mason, Horatio C., 151 West Eleventh Ave., Columbus 11, Ohio. *Tomato Fruitworm.*
'46. Mason, William R. M., Comstock Hall, Cornell University, Ithaca, N. Y. *Ichneumonoidea.*
'47. Massey, Calvin L., Forest Insect Investigations, Bureau of Entomology and Plant Quarantine, Fort Collins, Colo.

Ch. MATHESON, ROBERT, Cornell University, Ithaca, N. Y. (F. '28). *Ixodoidea, Culicidae.*
'36. Mead, Albert R., Department of Zoology, University of Arizona, Tucson, Ariz. *Chrysomelidae.*
'37. MEDLER, JOHN T., Department of Entomology, University of Wisconsin, Madison, Wis. (F. '47). *Cicadellidae.*
'25. Meiners, Edwin, Room 238, 6651 Enright, St. Louis 5, Mo. *Lepidoptera.*
Ch. MELANDER, A. L., 4670 Rubidoux Drive, Riverside, Calif. (F. '14). *Diptera.*
'27. Melvin, Roy, c/o Boyce Thompson Institute, 1086 N. Broadway, Yonkers 3, N. Y. *Physiology.*
'46. Mender, Manuel Barro, Calle 12, Nr. 220, Altos, Apart. 3, Vedado, Habana, Cuba.
'33. Menusan, Henry, Jr., 204 Agriculture Education Building, Pennsylvania State College, State College, Pa. *Physiology, Ecology.*
'23. Merrill, G. B., Plant Board, Seagle Building, Gainesville, Fla. *Coccidae, Aleyrodidae.*
'12. METCALF, C. L., Department of Entomology, University of Illinois, Urbana, Ill. (F. '20). *Syrphidae.*
'39. Metcalf, Robert L., Citrus Experiment Station, University of California, Riverside, calif. *Insect Physiology.*
'09. METCALF, Z. P., State College Station, Box 5215, Raleigh, N. C. (F. '34). *Homoptera.*
'35. MICHELBACHER, A. E., 112 Agricultural Hall, University of California, Berkeley 4, Calif. (F. '41). *Symphyla, Apoidea.*
'37. MICHENER, CHARLES D., American Museum of Natural History, 70th St. and Central Park West, New York, N. Y. (F. '44). *Apoidea.*
'17. MICKEL, CLARENCE E., Division of Entomology, University Farm, St. Paul 1, Minn. (F. '35). *Mutillidae.*
'36. Miller, Albert, Tulane Medical School, 1430 Tulane Ave., New Orleans, La. *Culicidae.*
'31. Miller, Albert C., P. O. Drawer 2038, Pittsburgh, 30, Pa. *Membracidae.*
'42. Miller, E. Morton, Department of Zoology, Box 452, University of Miami, Coral Gables, Fla. *Termites.*
'46. Miller, Ralph H., Chaffey College, Euclid at 5th, Ontario, Calif.
'37. Milliron, Herbert E., Division of Entomology and Economic Zoology, University of Minnesota, St. Paul, Minn. *Chalcidoidea, Bombidae.*
'29. MILLS, HARLOW B., Illinois Natural History Survey, Urbana, Ill. (F. '37). *Aptera.*
'37. MILNE, LORUS J., Department of Zoology, University of Vermont, Burlington, Vt. (F. 47). *Trichoptera.*
'25. Milum, Vern G., 104 Vivarium Building, University of Illinois, Champaign, Ill. *Apiculture.*
'43. el Minchaoui, Ibrahim, c/o Societe Generale des Sucreries et de la Raffinerie d'Egypte, P. O. B. 763, Cairo, Egypt. *Sugarcane pests.*
'26. MINNICH, D. E., Department of Zoology, University of Minnesota, Minneapolis 14, Minn. (F. '39). *Behavior.*
'38. Miroyiannis, Stanley D., Department of Biology, Northeastern University, Boston, Mass. *Histology.*
'39. Mitchell, Robert T., Patuxent Research Refuge, Bowie, Md. *Ichneumonidae and Braconidae.*
'21. MITCHELL, T. B., State College, Raleigh, N. C. (F. '37). *Apoidea, Megachile.*
'22. MONTGOMERY, B. ELWOOD, Department of Entomology, Purdue University, Lafayette, Ind. (F. '31). *Odonata, Coleoptera.*
'39. Moore, George A., 359 Querbes, Ave., Outremont, Quebec, Canada. *Hemiptera.*
'39. Moore, Warren, Bon Air, Va. *Dermestidae.*
'47. Morgan, Cecil V. G., Dominion Entomological Laboratory, Box 30, Summerland, British Columbia, Canada. *Mites.*
Ch. Morgan, H. A., 2424 Kingston Pike, Knoxville, Tenn.
Ch. MORRILL, A. W., 460 W. Longden Ave., Arcadia, Calif. (F. '39).
'12. MORRISON, HAROLD, Bureau of Entomology and Plant Quarantine, Washington, D. C. (F. '28). *Coccidae.*

'08. MOSHER, EDNA, R. R. #1, Newport, Nova Scotia, Canada. (F. '20). *Lepidoptera.*
'20. Mote, Don C., State Agricultural College, Corvallis, Ore. *Economic Entomology.*
'29. MOULTON, DUDLEY, 35 Elwood St., Redwood City, Calif. (F. '31). *Thysanoptera.*
'15. MUESEBECK, C. F. W., Bureau of Entomology and Plant Quarantine, Washington, D. C. (F. '34). *Braconidae, Bethylidae.*
'36. Mulrennan, J. A., State Board of Health, Box 201, Jacksonville, Fla. *Culicidae.*
'43. Muma, Martin H., Department of Entomology, University of Nebraska, Lincoln, Nebr.
'27. *Munro, J. A., State College Station, Fargo, N. D. *Orthoptera, Diptera.*
'37. Munson, Sam C., Department of Biology, George Washington University, Washington 6, D. C.
'35. *MURRAY, WILLIAM D., 4460 Rosemary Parkway, Columbus 2, Ohio. (F. '46). *Sphecidae.*
'28. MUSGRAVE, ANTHONY, Australian Museum, College Street, Sydney, New South Wales, Australia. (F. '41). *Nycteribiidae.*
'27. Musgrave, Paul N., 1956 Underwood Ave., Huntington, W. Va. *Dryopidae.*
'47. Myers, Theodore B., 1786 Gerrard Ave., Columbus 12, Ohio.

N

'46. Nakajima, Toshio, Entomological Institute, Fac. of Agr. Hokkaido, Sapporo, Imperial University, Japan. *Scarabaeidae.*
Ch. NEEDHAM, J. G., 6 Needham Place, Ithaca, N. Y. (F. '07, H. F. '35). *Odonata, Ephemerida.*
'21. Neiswander, C. R., Ohio Agricultural Experiment Station, Wooster, Ohio. *Insects of Ornamentals.*
'28. Neiswander, R. B., Ohio Agricultural Experiment Station, Wooster, Ohio. *Fruit Insects.*
'39. Nesbitt, Herbert H. J., 34 Lakeside Ave., Ottawa, Ontario, Canada. *Acarina.*
Ch. Ness, Henry, 821 Kellogg Ave., Ames, Iowa. *Economic Entomology.*
'34. Nevin, F. Reese, Plattsburg State Teachers College, Plattsburg, N. Y. *Morphology of Acarina.*
Ch. Newcomer, E. J., Box 1291, Yakima, Wash. *Fruit Insects.*
'15. Newman, George B., 246 East Hamilton Ave., State College, Pa. *Insect Histology.*
'28. Newton, Richard C., Bureau of Entomology and Plant Quarantine, Bozeman, Mont. *Alfalfa Weevil.*
'47. Nicolaides, George, U. S. Quarantine Station, Rosebank, Staten Island, N. Y.
'38. Nicholson, H. Page, U.S.P.H.S., C. D. C., Technical Development Division, Box 769, Savannah, Ga. *Simuliidae.*
'31. Nickels, C. B., Box 209, Bureau of Entomology, Brownwood, Tex. *Pecan Insects.*
'47. Nishida, Toshiyuki, 628 Marmion St., Honolulu 13, Hawaii.
'22. Noble, W. B., Bureau of Entomology and Plant Quarantine, Box 1857, Sacramento 9, Calif. *Cereal and Forage Insects.*
'38. Noland, Lowell E., Biology Bldg., University of Wisconsin, Madison, Wis.
'17. *Notman, Howard, Circle Road, Dougan Hills, Staten Island, N. Y. *Carabidae, Staphylinidae.*
'37. Nye, William P., Department of Entomology, Room 225, Utah State Agricultural College, Logan, Utah. *Forest Insects.*

O

'31. O'Byrne, Harold I., R. F. D. #1, Box 792, Glencoe, Mo. *Ecology, Lepidoptera.*
'44. Ogloblin, Alexander, 3120 Sanabria, Buenos Aires, Argentina.
'08. O'KANE, WALTER C., Durham, N. H. (F. '24).
'29. OMAN, PAUL W., Bureau of Entomology and Plant Quarantine, Washington 25, D. C. (F. '40). *Homoptera.*
'46. O'Neill, Kellie, U. S. D. A., Box 896, Macon, Ga. *Culicidae, Rhynchophora.*

'37. O'Neill, William J., Tree Fruit Branch Experiment Station, Box 596, Wenatchee, Wash. *Fruit Insects.*
'34. Oosthuizen, M. J., School of Agriculture, Potchefstroom, South Africa. *Stored Grain Insects.*
Ch. OSBORN, HERBERT, Ohio State University, Columbus, Ohio. (F. '07, H. F. '28). *Homoptera, Cicadellidae.*
'08. Osborn, H. T., 75 Highland Ave., Los Gatos, Calif. *Cicadellidae.*
Ch. OSBURN, R. C., Hancock Foundation, University of Southern California, Los Angeles 7, Calif. *Syrphidae.*
'43. Osmun, John V., Mountain Ave., Murray Hill, N. J.
'46. Owen, Robert P., 401 Washington Ave., Brooklyn, N. Y.
'36. Owen, William Bert, Department of Zoology, University of Wyoming, Laramie, Wyo. *Culicidae.*
'45. Owsley, William B., Kentucky Wesleyan College, Winchester, Ky. *Cerambycidae.*
'25. OZBURN, REG. H., Ontario Agricultural College, Guelph, Ontario, Canada. (F. '43). *Insect Histology.*

P

'15. Packard, Clyde M., Bureau of Entomology and Plant Quarantine, Washington, D. C. *Cereal and Forage Insects.*
'18. Painter, H. R., 705 Bexley Road, West Lafayette, Ind. *Phyllophaga.*
'19. PAINTER, R. H., Department of Entomology, Kansas State College, Manhattan, Kans. (F. '35). *Diptera, Bombyliidae.*
'39. Palm, Charles E., Department of Entomology, Cornell University, Ithaca, N. Y. *Forage Crop Insects.*
'37. Palmer, Boyd B.,, Polytechnic Institute, San German, Puerto Rico. *Trichoptera.*
'27. PALMER, MIRIAM A., 621 South Howes St., Fort Collins, Colo. (F. '37). *Aphidae.*
'47. Parfinowich, Sophy I., U. S. National Museum, Washington 25, D. C.
'27. PARK, ORLANDO, Department of Zoology, Northwestern University, Evanston, Ill. (F. '40). *Pselaphidae.*
'39. Parker, Barbara M., 635 Hinman Ave., Evanston, Ill.
'25. PARKER, H. L., European Parasite Laboratory, 58 Rue Jules Parent, Reuil-Malmaison, Seine et Oise, France. (F. '40). *Parasitic Hymenoptera.*
'24. Parker, R. L., Department of Entomology, Kansas State College, Manhattan, Kans. *Apiculture.*
'18. Parks, T. H., Department of Entomology, Ohio State University, Columbus, 10, Ohio.
'24. Parman, D. C., Box 509, Uvalde, Tex. *Diptera.*
'43. Parr, Thaddeus, Whitemarsh Research Laboratory, Box 4388, Chestnut Hill P. O., Philadelphia 18, Pa.
Ch. PARROTT, P. J., Agricultural Experiment Station, Geneva, N. Y. (F. '14).
'12. PARSHLEY, H. M., Department of Zoology, Smith College, Northampton, Mass. (F. '43). *Heteroptera.*
'32. PARSONS, CARL T., 238 East 62nd St., New York, N. Y. (F. '46). *Coleoptera.*
'34. Parten, Herbert H., Division of Entomology, University Farm, St. Paul 8, Minn. *Greenhouse Insects.*
'32. Passos, Cyril F. dos, Washington Corners, Mendham, N. J. *Lepidoptera.*
Ch. *PATCH, EDITH M., P. O. Box 150, Orono, Me. (F. '14). *Aphididae.*
'47. Patton, Robert L., Department of Entomology, Cornell University, Ithaca, N. Y.
'35. Paullus, Harold J., Midwest Division, California Packing Corporation, Rochelle, Ill.
'23. *PAYNE, NELLIE M., c/o American Cyanamid Company, Boston Post Road, Stamford, Conn. (F '40). *Physiology.*
'20. PEAIRS, L. M., Morgantown, W. Va. (F. '40).
'34. Pechuman, La Verne L., 7 Davison Road, Lockport, N. Y. *Tabanidae.*
'46. Peck, Oswald, Division of Entomology, Department of Agriculture, Confederation Building, Ottawa, Ontario, Canada. *Hymenoptera.*
'40. Pederson, Calvin E., Department of Entomology, Michigan State College, East Lansing, Mich. *Cicadellidae.*
'47. Pelot, Betty Lou, 1128 Connecticut St., Lawrence, Kans.

'37. Pelton, John Z., 205 First Ave., Waverly, Ohio. *Aquatic Insects.*
'47. Penn, George H., III, Department of Zoology, Tulane University, New Orleans 15, La. *Diptera, Culicidae.*
'35. Penner, Lawrence R., Department of Zoology and Entomology, University of Connecticut, Storrs, Conn. *Delphacidae, Muscoidea.*
'30. Pepper, Bailey B., Department of Entomology, Agricultural Experiment Station, New Brunswick, N. J. *Biological Control.*
'29. Peters, Harold T., State Teachers College, Bemidji, Minn. *Siphonaptera.*
'39. Peterson, Allan G., Division of Entomology, University Farm, St. Paul 1, Minn. *Potato Insects, Aphiidae, Miridae, Culicidae.*
'11. PETERSON, ALVAH, Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio. (F. '28). *Biological Control.*
'37. Peterson, Lloyd O. T., Indian Head, Saskatchewan, Canada. *Forest Entomology.*
'07. PETRUNKEVITCH, ALEXANDER, Yale University, New Haven, Conn. (F. '37). *Arachnida.*
'43. Pfadt, Robert E., Department of Entomology, University of Wyoming, Laramie, Wyo. *Orthoptera.*
'21. PHILLIPS, E. F., Cornell University, Ithaca, N. Y. (F. '29). *Apiculture.*
'47. Phillips, Grace R., 373 William St., East Orange, N. J.
'12. Phillips, W. J., 718 Cargill Lane, Charlottesville, Va. *Harmolita.*
'37. Phillips, W. Levi, 985 South Third East, Salt Lake City 4, Utah. *Lepidoptera.*
Ch. PIERCE, W. DWIGHT, 1074 Browning Blvd., Los Angeles 37, Calif. (F. '30). *Rhynchophora.*
'41. Platt, Fred R., Deputy Agricultural Commissioner, Court House, Riverside, Calif. *Coccidae, Coleoptera.*
'41. Pletsch, Donald J., Economic and Scientific Section, GHQ, SCAP, APO 500, c/o P. M., San Francisco, Calif. *Psyllidae, Myrmeleonidae.*
'28. PLUMMER, C. C., Apartado Number 3, Colonia Anahuac, Mexico, D. F., Mexico. (F. 44). *Membracidae.*
'18. POOS, FRED W., Beltsville Research Center, Beltsville, Md. (F. '43).
'23. Porter, B. A., Bureau of Entomology and Plant Quarantine, Washington, D. C. *Fruit Insects.*
'43. Porter, John E., 512 W. Nevada St., Urbana, Ill.
'35. Post, Richard L., Department of Entomology, University of North Dakota, Fargo, N. D. *Thysanoptera.*
'44. Potts, Robert W. L., Room 6, Agricultural Building, Embarcadero at Mission, San Francisco 5, Calif. *Scarabaeidae, Acaraeinae.*
'26. Potts, Samuel F., 56 Hillhouse Ave., New Haven, Conn. *Toxicology, Physiology.*
'36. *PRATT, HARRY D., U. S. Public Health Service, District No. 6, San Juan, Puerto Rico. (F. '46). *Ichneumonidae.*
'47. Pratt, John Jacob, Jr., Comstock Hall, Cornell University, Ithaca, N. Y.
'16. Price, W. A., University of Kentucky, Lexington, Ky. *Economic Entomology.*
'32. *PRITCHARD, A. EARL, Division of Entomology, University of California Berkeley, Calif. (F. '43). *Asilidae, Itonididae.*
'28. PROCTER, WILLIAM, Bar Harbor, Mr. (F. '40). *Insects of Mt. Desert Region.*
'33. Putnam, W. L., Dominion Entomological Laboratory, Vineland Station, Ontario, Canada. *Chrysopidae.*

Q

'36. Quarterman, Kenneth D., 7 Bright St., Savannah, Ga. *Cimicidae.*
'46. Quraishi, M. Sayeed, Fernald Hall, University of Massachusetts, Amherst, Mass.

R

'44. Ramos, J. A., Department of Biology, University of Puerto Rico, Mayaquez, Puerto Rico.
'42. Ramsay, Maynard J., 37 John St., Staten Island 2, N. Y. *Coleoptera, Larvae.*
'43. Rapp, William F., Jr., Gaylord Hall, Doane College, Crete, Nebr. *Diptera, Psychodidae.*
'14. RAU, PHIL, 549 East Argonne Drive 22, Kirkwood, Mo. (F. 27). *Hymenoptera, Behavior.*
,44. Redd, Jabus Constantine, Box 1538, State College, Miss.

'46. Redlinger, Leonard M., Entomology Department, Kansas State College, Manhattan, Kans. *Diptera—Empididae.*
'23. Reed, W. D., 3609 Military Road, N. W., Washington 15, D. C. *Tobacco Insects.*
'30. Rees, Don M., University of Utah, Salt Lake City, Utah. *Culicidae.*
'23. Reeves, Joseph A., 530 Federal Building, Buffalo 3, N. Y. *Chrysomelidae, Fulgoridae.*
'44. Reeves, William C., Hooper Foundation for Medical Research, San Francisco 22, Calif.
Ch. REHN, J. A. G., Academy of Natural Sciences of Philadelphia, 19th-The Parkway, Philadelphia 3, Pa. (F. '14). *Dermaptera, Orthoptera.*
'45. Reichart, Charles V., Department of Biology, Providence College, Providence 8, Rhode Island. *Hemiptera.*
'43. Remington, Charles L., Department of Zoology, Harvard University, Cambridge 38, Mass. *Thysanura, Entotrophi, Lepidoptera.*
'34. Rice, Paul L., Department of Entomology, Agricultural Experiment Station, Newark, Del. *Chalcidoidea.*
'30. RICHARDS, A. GLENN, JR., Entomology Department, University Farm, St. Paul 1, Minn. (F. '38). *Noctuidae.*
'14. RICHARDSON, CHARLES H., Department of Entomology, Iowa State College, Ames, Iowa. (F. '31). *Physiology.*
'29. RICHARDSON, MAJ. H. H., U.S.D.A. Quarantine Inspection Station, 209 River St., Hoboken, N. J. (F. '41). *Physiology.*
'28. Richmond, Edward A., 31 Rosemont Ave., Frederick, Md. *Hydrophilidae.*
'46. Ricker, William E., Department of Zoology, Indiana University, Bloomington, Ind. *Plecoptera.*
'39. Riedel, F. A., 2894 Dexter St., Denver 7, Colo.
'43. Rieder, Robert E., Shell Oil Co., Terminal Sales Building, Portland 5, Ore.
'39. Riegel, Garland T., Department of Entomology, University of Illinois, Urbana, Ill. *Braconidae.*
'22. Ries, Donald T., Department of Biology, Illinois State Normal University, Normal, Ill. *Cephidae, Siricidae.*
'40. Riherd, Paul T., Box 42, Stafford, Tex. *Truck Crop Insects.*
Ch. RILEY, WILLIAM A., Department of Zoology, University of Minnesota, Minneapolis, Minn. (F. '14). *Parasitology.*
'39. Rings, Roy W., 1158 Oakland Ave., Columbus, Ohio. *Cerambycidae.*
'33. RITCHER, PAUL O., Agricultural Experiment Station, Lexington, Ky. (F. '44). *Phyllophaga.*
'36. Ritchie, C. L., Box 340, Honolulu 9, Hawaii. *Coccidae, Lepidopterous Larvae.*
'47. Rivero, Juan A., Biology Department, College of Agriculture, Mayaquez, Puerto Rico.
'39. Roark, R. C., Bureau of Entomology and Plant Quarantine, Beltsville, Md. Insecticides.
'47. Roback, Selwyn S., 3 Grove Place, Ithaca, N. Y. *Diptera.*
'40. Roberts, H. Radclyffe, Box 490, Bryn Mawr, Pa. *Acrididae.*
'31. Roberts, J. Harvey, Box 8729, University, La. *Trichoptera.*
'43. Roberts, Reed S., 346 West First North, Logan, Utah.
'45. Robinson, John H., P. O. Box 63, Barksdale Field, La.
'15. Robinson, J. M., Box 671, Auburn, Ala. *Dermestidae.*
'45. Robinson, Paul Francis, 21 Fenwood Road, Boston 15, Mass.
'26. ROBINSON, WILLIAM, Burnt Mills Hills, Silver Spring, Md. (F. '39). *Physiology.*
'41. Rockstein, Morris, Division of Entomology, University of Minnesota, University Farm, St. Paul, Minn.
'13. Rockwood, L. P., 130 Third Ave. S. E., Forest Grove, Ore. *Noctuidae, Orthoptera.*
'31. Rodeck, Hugo G., University of Colorado Museum, Boulder, Colo. *Nomada.*
'44. Rodock, Roy Edgar, Lewiston State Normal School, Lewiston, Idaho.
'47. Rodriguez, Juan G., Department of Entomology, Ohio Agricultural Experiment Station, Wooster, Ohio.
'15. ROGERS, J. SPEED, Museum of Zoology, University of Michigan, Ann Arbor, Mich. (F. '43). *Tipulidae.*
'41. *Rogoff, William M., University of California, Citrus Experiment Station, Riverside, Calif.

'27. ROHWER, S. A., Bureau of Entomology and Plant Quarantine, Washington, D. C. (F. '29). *Hymenoptera.*
'25. Rosewall, O. W., Box 8729, Department of Entomology, Louisiana State University, Baton Rouge 3, La. *Coleoptera, Pentatomidae.*
'39. ROSS, EDWARD S., Department of Entomology, California Academy of Sciences, Golden Gate Park, San Francisco 18, Calif. *Histeridae, Embioptera.*
'31. ROSS, HERBERT H., Illinois Natural History Survey, Urbana, Ill. *Sawflies, Caddisflies.*
'12. Ross, William A., Vineland Station, Ontario Canada. *Aphidae.*
'40. Roth, Louis M., Quartermaster Research and Development Laboratories, Biological Laboratories, Philadelphia Quartermaster Depot, 2800 South 20th St., Philadelphia 45, Pa. *Diptera, Culicidae.*
'36. ROZEBOOM, LLOYD EUGENE, School of Hygiene and Public Health, 615 North Wolf St., Baltimore 5, Md. (F. '46). *Culicidae.*
'14. RUCKES, HERBERT, 167-11 33rd Ave., Flushing, New York, N. Y. (F. '47). *Pentatomidae.*
'39. Rude, Clifford S., Abasolo 518 Ote, Torreon, Coah., Mexico. *Ixodidae.*
'46. Russell, Louise M., Bureau of Entomology and Plant Quarantine, Washington 25, D. C.
'42. Ryan, George S., R. R. #4, Angola, Ind. *Noctuiidae.*

S

'33. *SABROSKY, CURTIS W., Division of Insects, U. S. National Museum, Washington, D. C. (F. '41). *Chloropidae.*
'41. Sailer, Reece I., Division of Insects, U. S. National Museum, Washington 25, D. C. *Hemiptera.*
'38. Sailsbury, Murl B., 824 Gaffield Place, Evanston, Ill. *Chrysomelid Larvae.*
'46. Sakagami, Shoichi, Entomological Institute, Hokkaido, Imperial University, Sapporo, Hokkaido, Japan.
'29. Sakimura, K., Pineapple Research Institute, Box 3166, Honolulu 2, Hawaii. *Thysanoptera.*
'46. Sallee, Roy M., 131 North Normal Street, Macomb, Ill. *Formicidae.*
'37. Sampson, William W., 156 South Fourteenth St., Richmond, Calif. *Aphidae, Aleurodidae.*
'31. SANDERSON, MILTON W., Illinois Natural History Survey, Urbana, Ill. (F. '43). *Coleoptera.*
'07. SATTERTHWAIT, A. F., 806 Ohio St., Urbana, Ill. (F. '30). *Calendra.*
'46. Sawamoto, Takahisa, Hokkaido Forest Experiment Station, Toyohira 5 jo 13 chome, Sapporo, Japan. *Scolytidae, Scolydoplatopidae, Platypodidae.*
'29. Scaramuzza, L. C., Central Mercedes, Prov. of Matanzas, Cuba. *Sugar Cane Insects.*
'30. Schlosberg, Morris, P. O. Box 606, West Lafayette, Ind. *Lepidoptera.*
'29. Schmidt, Carl T., Box 3166, Honolulu, Hawaii. *Ecology.*
'33. Schmidt, Helen D. O'Neil, Box 3166, Honolulu, Hawaii. *Trichoptera.*
'20. SCHMIEDER, RUDOLF G., Zoology Laboratory, University of Pennsylvania, Philadelphia, Pa. (F. '47). *Hymenoptera.*
'32. SCHMITT, JOHN B., Department of Entomology, New Jersey Agricultural Experiment Station, New Brunswick, N. J. (F. '43). *Morphology.*
'34. Schmitt, T. J., Jr., Apt. 16, 1086 Corona St., Denver 3, Colo. *Scolytidae.*
'44. Schnitzer, Robert C.
Ch. SCHOENE, W. J., Agricultural Experiment Station, Blacksburg, Va. (F. '44).
'47. Schoenherr, William H., P. O. Box 673, Danville, Ill.
'36. Schoof, Herbert F., 302 Horne St., Raleigh, N. C. *Chrysomelidae.*
'29. Schroeder, H. O., 5601 Patrick Henry Drive, Baltimore, Md. *Ixodoidea, Argasidae.*
'40. Schuh, Joe, 705 NE 97th St., Portland 16, Ore. *Odonata.*
'26. SCHWARDT, H. H., Department of Entomology, Cornell University, Ithaca, N. Y. (F. '35). *Tabanidae.*
'26. SCHWARZ, HERBERT F., American Museum of Natural History, 70th St. and Central Park West, New York, N. Y. (F. '37). *Meliponidae.*
'28. Scotland, Minnie B., 42 Continental Ave., Cohoes, N. Y. *Lemna Insects.*
'46. Scudder, Harvey I., Department of Entomology, Cornell University, Ithaca, N. Y. *Culicidae, Coleoptera, Lampyroidea.*

'25. SCULLEN, H. A., Department of Entomology, Oregon State College, Corvallis, Ore. (F. '40). *Cerceridae.*
'46. Seabrook, Edwin L., County Courthouse Annex, West Palm Beach, Fla.
'23. Seamans, H. L., 616 Confederation Building, Ottawa, Ontario, Canada. *Muscoidea.*
'41. Sears, Jack W., B. L. 319, University of Texas, Austin 21, Tex.
'36. SEEVERS, CHARLES H., Roosevelt College, 420 South Michigan, Chicago 5, Ill. (F. '46). *Termitophiles, Staphylinidae (Aleocharinae).*
'08. SEVERIN, H. C., South Dakota State College, Brookings, S. D. (F. '39). *Orthoptera, Homoptera, Heteroptera.*
'07. SHAFER, GEORGE D., 321 Melville Ave., Palo Alto, Calif. (F. '41). *Physiology.*
'46. Sharp, S. S., Department of Zoology and Entomology, Iowa State College, Ames, Iowa. *Toxicology.*
'35. SHAW, FRANK R., Fernald Hall, Massachusetts State College, Amherst, Mass. (F. '46). *Mycetophilidae.*
'29. Shaw, John G., Laboratorio Entomologico, Apt. Number 3, Colonia Anhuac, D. F., Mexico.
Ch. SHELFORD, V. E., Vivarium Building, Wright and Healy Sts., Champaign, Ill. (F. '20). *Ecology.*
'43. Shenefelt, Roy D., Department of Entomology, University of Wisconsin, Madison 6, Wis.
'22. SHEPARD, HAROLD H., Insecticide Testing Laboratory, U.S.D.A., Beltsville, Md. (F. '39). *Hesperiidae.*
'11. SHERMAN, JOHN D., JR., 132 Primrose Ave., Mt. Vernon, N. Y. (F. '39). *Dytiscidae.*
'34. Shields, S. E., 346 Berry Field, Nashville, Tenn. *Culicidae.*
'35. *Shockley, Wilfred, 1180 Sherman St., Denver 3, Colo. *Cerambycidae, Decticinae.*
'28. Shropshire, Leslie H., c/o Fairmont Packing Company, Fairmont, Minn. *Economic Entomology.*
Ch. SHULL, A. FRANKLIN, 431 Highland Road, Ann Arbor, Mich. (F. '39). *Aphididae.*
'15. SILVESTRI, FILIPPO, Scuola Superiore d'Agricoltura, Portici, Italy. (F. '20). *Thysanura, Protura, Termites, Myriopoda.*
'42. Simmonds, Frederick J., Imperial Parasite Service, Belleville, Ontario, Canada.
'29. Simmons, Perez, 712 Elizabeth St., Fresno 3, Calif. *Dried Fruit Insects.*
'39. Simonds, William E., R. F. D. #1, Box 26, Ojai, Calif. *Elateridae.*
'30. *Simpson, Geddes W., Holmes Hall, Orono, Me. *Insects and Plant Diseases.*
'38. Singleton, J. M., 209 River St., Hoboken, N. J. *Quarentines.*
'46. Slater, James A., Department of Zoology and Entomology, Iowa State College, Ames, Iowa.
'43. Slifer, Eleanor H., Department of Zoology, State University of Iowa, Iowa City, Iowa.
'32. Smith, Carroll N., 710 East Concord Ave., Orlando, Fla. *Ixodidae.*
'32. Smith, Charles E., Agricultural Experiment Station, University Branch, Baton Rouge, La. *Truck Crop Insects.*
'35. SMITH, CLYDE F., Department of Entomology, University of North Carolina, Raleigh, N. C. (F. '46). *Aphididae.*
'27. SMITH, FLOYD F., Agricultural Research Center, Beltsville, Md. (F. '43). *Aphididae, Taisonemidae.*
'41. Smith, Gordon F., P. O. Box 907, Bakersfield, Calif. *Diptera.*
'35. Smith, Howard W., 919 N. Fourth St., Manhattan, Kansas.
'37. Smith, Marion E., Fernald Hall, Massachusetts State College, Amherst, Mass. *Arctiidae.*
'19. SMITH, MARION R., Room 377, U. S. National Museum, Washington 25, D. C. (F. '38). *Formicidae.*
'42. Smith, Ray F., 112 Agriculture Hall, University of California, Berkeley 4, Calif. *Diabrotica, Colias.*
'14. SMITH, ROGER C., Department of Entomology, Kansas State College, Manhattan, Kans. (F. '31). *Neuroptera.*
'44. Smith, William Ward, U.S.P.H.S., Jackson 113, Miss.
'18. Snapp, Oliver I., Box 527, Fort Valley, Ga. *Rhynchophora.*

'39. Snipes, B. Thomas, Dodge & Olcott, Inc., P. O. Box 550, Powell, Wyo. *Siphonaptera.*
'24. SNODGRASS, R. E., 3706 Thirteenth St. N. W., Washington 10, D. C. (F. '27). *Morphology.*
'45. Snow, Willis E., Department of Entomology, University of Illinois, Urbana, Ill.
'44. Snyder, Everett G., Department of Biological Science, Michigan State College, East Lansing, Mich. *Diptera, Morphology and Economic Entomology.*
'36. Snyder, Fred M., 721 Oak Ave., Orlando, Fla. *Muscoidea.*
'38. Sommerman, Kathryn M., Division of Parasitology, Army Medical School, A.M.C., Washington 12, D. C. *Carrodentia.*
'26. Sorenson, Charles J., Agricultural Experiment Station, Logan, Utah. *Miridae.*
'14. *Spencer, G. J., University of British Columbia, Vancouver, British Columbia, Canada. *Trypetidae.*
'19. SPENCER, HERBERT, Box 112, Fort Pierce, Fla. (F. '37). *Hymenoptera, Citrus Insects.*
Ch. SPOONER, CHARLES S., 1436 Seventh St., Charleston, Ill. (F. '43). *Fulgoridae.*
'30. Stanley, W. W., Agricultural Experiment Station, Knoxville, Tenn. *Phalaenidae.*
'46. *Stannard, Lewis J., Jr., Illinois Natural History Survey, Urbana, Ill. *Thysanoptera.*
'35. Stehr, William C., Department of Zoology, Ohio University, Athens, Ohio. *Coccinellidae, Carabidae.*
'27. Steiner, L. F., 1237 Washington Ave., Vincennes, Ind. *Fruit Insects.*
'46. Steinhaus, Edward A., Insect Pathology Laboratory, University of California, Berkeley 8, Calif.
'29. Steinweden, John B., Bureau of Nursery Service, State Department of Agriculture, Sacramento, Calif. *Coccidae, Thysanoptera.*
'31. STEWART, M. A., Division of Entomology, 112 Agriculture Hall, University of California, Berkeley, Calif. (F. '41). *Siphonaptera.*
'15. Stiles, Charles F., Box 29, Stillwater, Okla.
'23. Stirrett, George M., Dominion Entomological Laboratory, Chatham, Ontario.
'38. Stitt, Loyd L., Western Washington Experiment Station, Puyallup, Wash. *Miridae.*
'27. STONE, ALAN, Bureau of Entomology and Plant Quarantine, Washington 25, D. C. (F. '40). *Simuliidae, Tabanidae, Culicidae.*
'36. Stone, Philip C., 105 Whitten Hall, University of Missouri, Columbia, Mo. *Ixodidae.*
'28. Stone, William E., Laboratorio Entomologica, Apartado Number 3, Colonia Anahuac, D. F., Mexico.
'42. Strandtmann, R. W., Department of Preventive Medicine, Medical Branch, University of Texas, Galveston, Texas. *Specidae, Acarina: Laelaptidae.*
'12. Strickland, E. H., Main Library, University of Alberta, Edmonton, Alberta, Canada. *Elateridae.*
'25. Strohecker, H. F., Department of Zoology, University of Miami, Coral Gables 34, Fla. *Orthoptera.*
'34. Strom, L. G., Box 992, U.S.P.H.S., Brownsville, Texas. *Aphiidae.*
'46. Strong, Rudolph G., P. O. Box 1538, State College, Miss.
'31. Summerour, A. R., Box 173, Lucedale, Miss.
'23. SWEETMAN, HARVEY L., State College, Amherst, Mass. (F. '43). *Ecology.*
'20. SWEZEY, OTTO H., 2044 Lanihuli Drive, Honolulu 5, Hawaii. (F. '30). *Delphacidae, Lepidoptera.*
'44. Swift, Hewson H., 535 W. 113th St., New York 25, N. Y. *Araneida, Ichneumonidae.*

T

'46. Takahsi, Hirosi, Entomological Institute, Hokkaido Imperial University, Sapporo, Japan. *Simuliidae and Tabanidae.*
'37. Talbot, Mary, Lindenwood College, St. Charles, Mo. *Formicidae.*
'47. Tanada, Yoshinori, 511 Hiram Lane, Honolulu 22, T. Hawaii.
'36. Tanner, M. C., 2902 Jackson Ave., Ogden, Utah. *Plecoptera.*

'27. TANNER, VASCO M., Brigham Young University, Provo, Utah. (F. '46). *Tenebrionidae, Carabidae.*
'31. Tate, H. Douglas, U. S. Rubber Co., Naugatuck Div., Bethany 15, Conn.
'36. *TAUBER, OSCAR E., Department of Zoology, Iowa State College, Ames, Iowa. (F. '47). *Physiology.*
'47. Taylor, Earl J., 174 North 1 West, Logan, Utah.
'22. Taylor, Leland H., Department of Botany, West Virginia University, Morgantown, W. Va. *Aculeate Hymenoptera.*
'34. *Telford, Horace S., Washington State College, Department of Zoology, Pullman, Wash. *Syrphidae.*
'47. Telford, Paul E., Department of Zoology and Entomology, Ohio State University, Columbus 10, Ohio.
'40. Thatcher, T. O., 700 S. 31st St., Apt. 2C, Richmond, Calif. *Scolytidae, Buprestidae, Cerambycidae.*
'21. Thomas, Charles A., State College Laboratory, Kenneth Square, Chester County, Pa. *Elateridae, Scarabaeidae.*
'32. THOMAS, EDWARD S., Ohio State Museum, Ohio State University, Columbus 10, Ohio. (F. '46). *Orthoptera.*
'38. Thomas, Henry D., North Park College, Foster and Kedzie, Chicago 25, Ill.
'15. Thomas, F. L., Agricultural Experiment Station, College Station, Texas. *Cotton Insects.*
'39. Thompson, W. L., Box 1074, Lake Alfred, Fla. *Citrus Insects.*
'10. THOMPSON, W. R., 228 Dundas St., Belleville, Ontario, Canada. (F. '27). *Tachinidae.*
'47. Thornton, Dorothy Golden, 7407 Dickinson Ave., College Park, Md.
'46. Thurman, Deed C., Jr., CDC Activities, U.S.P.H.S., P. O. Box 210, Jacksonville, Fla. *Culicidae.*
'22. TIETZ, HARRISON M., Department of Zoology, Pennsylvania State College, State College, Pa. (F. '46). *Noctuidae.*
'11. TIMBERLAKE, P. H., Citrus Experiment Station, Riverside, Calif. (F. '38). *Encyrtidae.*
'23. Tissot, A. N., Agricultural Experiment Station, Gainesville, Fla. *Aphididae.*
'26. Todd, F. E., c/o Bee Culture, Beltsville, Mad. *Apiculture.*
'33. *TOWNES, HENRY K., JR., 17 Elm St., McLean, Va. (F. '43). *Ichneomonidae, Chironomus.*
'28. Towsend, Lee H., Department of Entomology, University of Kentucky, Lexington, Ky. *Neuroptera.*
'36. TRAGER, WILLIAM, Rockefeller Institute, Princeton, N. J. (F. '47). *Insect Nutrition.*
'39. Traub, Major Robert, Department of Parasitology, A.M.D.R.G.S., Army Medical Center, Washington 12, D. C.
'46. Travassos, Lauro P., Department of Zoologia, Sec. da Agricultura, C. postal 172-A, Sao Paulo, S. P., Brazil.
'30. TRAVER (MISS) JAY R., Fernald Hall, Massachusetts State College, Amherst, Mass. (F. '35). *Ephemeridae.*
'30. Travis, Bernard V., Box 3391, Orlando, Fla. *Culicidae.*
'39. Trembley, Helen L., National Institute of Health, Bethesda 14, Md.
'47. Truman, Lee C., 2701 Winthrop Ave., Indianapolis 5, Ind.
'47. Truxal, Frederick A., 505 Lane 11, Sunflower Village, Lawrence, Kans.
'34. Trippel, A. W., Indiana Department of Conservation, Box 408, Auburn, Ind. *Chrysomelidae.*
'38. Tuck, Joseph B., Morrisville, Mo. *Orthoptera.*
'28. Tulloch, George S., Department of Biology, Brooklyn College, Bedford Avenue and Avenue H., Brooklyn 10, N. Y. *Morphology.*
'08. Turner, William F., P. O. Box 162, Fort Valley, Ga.
'29. *TUTHILL, L. D., University of Hawaii, Honolulu, Hawaii. (F. '43). *Psyllidae, Fulgoridae.*

U

'47. Ullyett, Gerald Cumming, 228 Dundas St., Belleville, Ontario, Canada.
'32. USINGER, ROBERT L., Division of Entomology, University of California, Berkeley, Calif. (F. '41). *Heteroptera, except Corixidae.*

V

'22. Vance, Arlo M., Box 606, West Lafayette, Ind. *Ecology.*
Ch. Van Dine, D. L., 805 Crescent Drive, Alexandria, Va. *Fruit Insects.*
Ch. Van Dyke, E. C., Department of Entomology, California Academy of Science, Golden Gate Park, San Francisco, Calif. (F. '17). *Coleoptera.*
'39. Vazquey, Leonila (Miss), Instituto de Biologia, Casa del Lago, Chapultepec, D. F., Mexico. *Psychidae.*
'43. Vernard, Carl E., Department of Zoology, Ohio State University, Columbus 10, Ohio.
'48. Vincent, Lloyd E., Division of Entomology, Citrus Experiment Station, Riverside, Calif.
'40. Vogt, George B., University of Maryland, College Park, Md. *Coleoptera, Hemiptera.*

W

'15. Wade, J. S., Bureau of Entomology and Plant Quarantine, Washington, D. C. (F. '37). *Coleoptera.*
'21. Wadley, F. M., 3215 N. Albemarle, Arlington, Va. (F. '39). *Aphididae.*
'18. Wainwright, C. J., 50 Christchurch Road, Bournemouth, England. *Tachinidae.*
'22. Walkden, Herbert H., Bureau of Entomology and Plant Quarantine, 201 Post Office Building, Hutchinson, Kans. *Noctuidae.*
'10. Walker, E. M., Department of Biology, University of Toronto, Toronto 5, Ontario, Canada. (F. '14). *Odonata, Orthoptera.*
'30. Walker, Harry G., R. F. D. #1, Langhorne, Pa. *Economic Entomology.*
'38. Wallace, George E., Department of Entomology, Carnegie Museum, Pittsburgh, Pa. *Chalcididae.*
'46. Wallace, Herbert S., Department of Entomology, University of Kansas, Lawrence, Kans. *Acrididae.*
'23. Wallace, Hugh E., 210 Santa Rita, Modesto, Calif.
'32. Walley, G. Stuart, Entomological Branch, Ottawa, Ontario, Canada. (F. '41). *Hymenoptera, Hemiptera.*
'37. Walter, E. V., Box 495, Lafayette, Ind. *Economic Entomology.*
'47. Walters, Hubert J., 203 Harker Hall,
'17. Walton, William R., 4323 Madison St., Hyattsville, Md. (F. '37).
'46. Watanabe, Chihisa, Entomological Institute, Hokkaido Imperial University, Sapporo, Hokkaido, Japan. *Parasitic Hymenoptera.*
'25. Watson, S. A., Friends University, Wichita 12, Kans. *Miridae, Hemiptera.*
'46. Watson, Wynnfield Y., 1c Benlamond Avenue, Toronto 13, Canada. *Coleoptera.*
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A CONTRIBUTION TO THE PHYLOGENY OF THE MYCETOPHILIDAE[1]

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The interest of the author was drawn to the study of thoracic sclerites as possible aids in the determination of the relationships of insects. In 1925, Dr. Crampton presented data to indicate the interrelationship of the non-tipuloid Nematocera based on a study of thoracic sclerites From time to time, the author had made random observations on the shape of pleural sclerites in the Mycetophilidae, but until the present time, no attempt has been made to classify this family by the use of these sclerites.

It is recognized that the number of forms studied is far from complete However, certain tendencies appear to be observable. It is hoped that the study will serve to stimulate interest in this group and that someone will develop this work to cover all of the genera.

In most cases the studies were made on males which were preserved in 80% alcohol. In a few instances only dried specimens were available. These were boiled in KOH, soaked in water, and then preserved in alcohol. The setae are omitted intentionally in order to present clearly the shape of the sclerites. Credit is given to Elmer Smith for the preparation of all the figures. Without his able assistance, the present work could not have been completed.

Before trying to develop a phylogenetic grouping for the genera of the Mycetophilidae, it will be best to discuss briefly some of the concepts concerning the evolution of the entire family. It is felt that this is essential in order to form an opinion of what a primitive or generalized Mycetophilid may be.

Enderlein, 1911, presented views concerning the interrelationships of the family. He derived the Mycetophilidae, the Bibionidae, the Scatopsidae, and the Cecidomyiidae from a common ancestry. Within the Mycetophilidae he appears to have regarded the Ceroplatinae as most primitive. The Macrocerinae were apparently derived from an ancestral stock similar to that of the Ceroplatinae. This view seems

[1]The author wishes to express his gratitude to Drs. C. P. Alexander and G. C. Crampton for their interest and helpful suggestions.

to be substantiated by some later workers who have indicated that the Macrocerinae should be included in the Ceroplatinae. The author does not agree with that grouping.

According to Enderlein the Bolitophilinae, the Pachyneurinae, the Mycetobinae and the Diadocidinae all were developed from one common stock. Of these, the Bolitophilinae were considered the most primitive.

The Sciophilinae and the Mycetophilinae were considered to have evolved from a distinct stock more closely related to the Simuliidae, the Cecidomyidae, the Scatopsidae and the Bibionidae and the Sciarinae than are the other Mycetophilid genera. It is probable that this is based on the opinion that the Sciarinae may have evolved through the Sciophilinae. I do not agree with this concept since I feel that the resemblance of certain Sciophiline genera to the Sciarinae is a case of parallel development.

Enderlein considered that the Sciarinae were more closely related to the Lestremiinae of the Cecidomyiidae than to the Mycetophilids. This is based on the presence of a dorsal eye bridge in both groups. Considerable controversy has existed concerning this grouping. Edwards has considered that the larvae of Mycetophila and Sciara show evidence of having been derived from a common stock on the basis of specialized labial structures and similar tracheal systems. On the basis of the present studies the Sciarinae show relationships with *Hesperinus* (Bibionide); *Catocha* and *Rhabdophaga* of the Cecidomyiidae. This is evidenced by the presence of a midpleural pit in all four genera, by the general shape of the katepisternum, and the presence of a precoxal bridge. The present study would support the belief that the Sciarinae, while of Mycetophilid stock, have characters sufficiently distinct to justify their being a separate family.

Crampton, 1925, considered that the Mycetophiliodea, i. e., Mycetobiidae, Mycetophilidae, and the Sciaridae, arose from the Anisopodidae themselves or from forms extremely like the Anisopodidae. Crampton felt that it would be extremely difficult to determine whether to group the annectant form, the Mycetobiidae, with the Anisopodidae or the Mycetophilidae. The same author considered that the Sciaridae are rather primitive Mycetophiloids and indicated that they should be given family rank. He did not feel that the Bolitophilinae, while primitive, are deserving of family rank, nor does he agree with Malloch that the Platyurinae should be raised to the same level.

Edwards, 1925, does not agree that *Mycetobia* represents an annectant form between the Mycetophilidae and the Anisopodidae. This view is based on the fact that the tracheal system of Mycetophila is more primitive than that of *Mycetobia*. I feel that Crampton's views concerning the relationship of *Mycetobia*, the Anisopodidae and the Mycetophilidae are more logical than those of Edwards.

Crampton, 1925, considered that the Cecidomyiidae are closely related to the Mycetophilidae and should be included in the superfamily Mycetophiloidea. This is based on the narrowing of the mesothoracic epimeron and the reduction of the meron, both of which characters occur in the Mycetophilidae. Crampton considered that the Bibionidae were derived from the same ancestral stock as the Mycetophiloidea and in a sense were intermediate between this group and the Chironomoidea.

Edwards stated that about the beginning of the Jurassic period, if not earlier, the Diptera were divided into three main groups. The first included the Mycetophilidae, Bibionidae, Scatopsidae, and Cecidomyiidae; the second, the Ptychopteridae, Culicidae, Psychodidae, and Chironomidae; the third, the Trichoceridae and the Tipulidae.

In 1942, Crampton advanced the belief that three main stocks arose from an Anisopodid-like ancestor. One branch gave rise to Mycetophilidae, Sciaridae and Cecidomyiidae, a second branch to Mycetobiidae, Anisopodidae and Trichoceridae, and a third to the Hesperinidae, Bibionidae, and the Scatopsidae.

The author feels that the Sciaridae possess characters indicating close relationship with the Mycetophilidae, the Bibionidae, and the Scatopsidae on the basis of the structure of the pleura.

With this as an introduction, I would like now to consider inter-relationships among the Mycetophilidae. Meunier, 1904, advanced the belief that the Sciarinae were the most primitive with other members of the family being derived from this group.

Apparently Meunier considered the Bolitophilinae to be the most primitive of the Mycetophilidae excluding the Sciarinae. The Ceroplatinae, Macrocerinae, Mycetobiinae, and the Diadocidinae were represented as having been derived from the Bolitophilinae along similar lines. He derived the higher forms through the Sciophilinae which were a direct offshoot from the Bolitophilinae. The Bolitophilinae, while admittedly primitive, do possess some specializations which are not found in forms supposedly derived from the group. Some venational characters appear in *Bolitophila* which are not as primitive as those found in *Palaeoplatyura*

Fisher, in correspondence, presented a scheme to show the inter-relationship of the various groups. Her concepts are based on the study of the male genitalia as well as other characters. From her diagram, Fisher derived the subfamilies from a common ancestor with 5 main divisions. According to her beliefs, the subfamily Ditomyiinae is the most primitive of the Mycetophilidae The Bolitophilinae are the second most primitive group, followed by the Diadocidinae. The Macrocerinae and Ceroplatinae were believed to have originated from a common stock a little higher in development than the Diadocidinae. She considered that the Mycomyiini arose next and gave rise to the Exechini and Mycetophilini The Sciophilini, Gnoristini and Leiini were from the same stock. She considers that the Sciarinae arose from the Leiini

With the exception of the development of the Sciarinae, my findings agree in the main with those of Fisher. I do consider that the Ditomyiinae are more highly evolved than certain of the Ceroplatinae.

With this as a review of what earlier writers have proposed I would like to begin a discussion of the findings of my study. Before doing this, I would like to indicate the features that seem to be primitive.

1. In all of the more primitive forms—*Sciara*, *Bolitophila*, *Palaeoplatyura*, *Symmerus*, *Apemon*—the mesothoracic episternum is unequally divided, resulting in the katepisternum being much larger than the anepisternum.

2. In the same forms, the anepisternum is divided by a cleft into an anterior and posterior portion.

3. In the more primitive forms, the pronotum is divided into two distinct portions. This is not the case in the higher forms.

4. In the more primitive forms, the mesothoracic epimeron, while narrower ventrally, does reach to the base of the mesothoracic coxa. In the more specialized forms the pleurotergite seems to develop anteriorly, thus narrowing the epimeron and in some cases cutting it off.

5. In the more primitive forms there is an indication of a suture separating the prescutum of the mesonotum from the scutum. This is lacking in the higher forms.

6. The presence of a meron is probably a primitive one. It is found in *Bolitophila*, *Apemon*, and there are indications of it in *Platyura* and some other forms. However, it is apparently reduced in *Palaeoplatyura* which, on the basis of venation, is more primitive than *Bolitophila*.

7. The more nearly perpendicular the mesopleural suture, the more primitive is the genus.

Having considered the characters which I consider to be primitive, I now wish to consider the various genera on the basis of these characters.

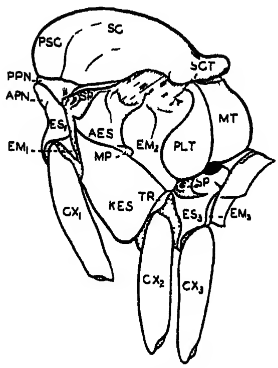
Sciara, figure 1, has a relatively large katepisternum, a wide epimeron, a distinct division of the pronotum into two portions. However, the mesosternal suture is destinctly angulate and the katepisternum is similar to that of *Herperinus*, *Catocha*, and *Rhabdophaga*. *Sciara* possesses a mid pleural pit as is shown in all of the three genera mentioned. The meron appears to be lacking. The sclerite indicated at the base of the mesothoracic coxa is probably the trochanter. It differs in these respects from other Mycetophilids and I feel that this evidence supports the concept that the Sciarinae represents a distinct family and I so propose to treat it.

Bolitophila, figure 2, possesses all of the thoracic characters I consider primitive with the exception that the indication of a suture distinguishing the prescutum and scutum of the mesonotum is not as distinct as it is in *Palaeoplatyura*. It is certainly near the base of the ancestral stock.

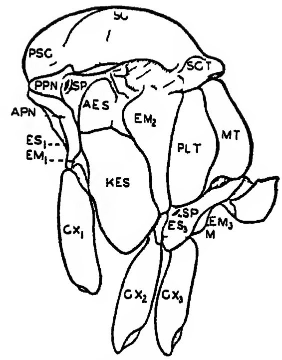
Symmerus, figure 3, while primitive as regards venation, is apparently somewhat specialized in other ways. The latepisternum is large and the anepisternum is divided as in *Bolitophila*. It is possible that what

LIST OF ABBREVIATIONS

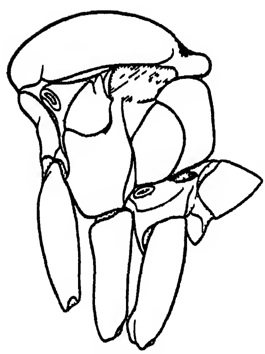
AES—Anepisternum of mesothorax.
APN—Anterior pronotum — pronotal scutum.
CX_1Prothoracic coxa.
CX_2Mesothoracic coxa.
CX_3Metathoracic coxa.
CXS—Coxal spur.
EM_1—Prothoracic epimeron.
EM_2—Mesothoracic epimeron.
EM_3—Metathoracic epimeron.
ES_1—Prothoracic episternum.
ES_3Metathoracic episternum.
KES—Katepisternum of mesothorax.
M—Meron.
MP—Midpleural pit.
MT—Mediotergite.
PLT—Pleurotergite.
PN—Post.
PPN—Posterior pronotum—pronotal scutellum.
PSC—Prescutum of mesonotum.
SC—Scutum of mesonotum.
SCT—Scutellum of mesonotum.
SP—Spiracle.
TR—Pleurotrochanter.



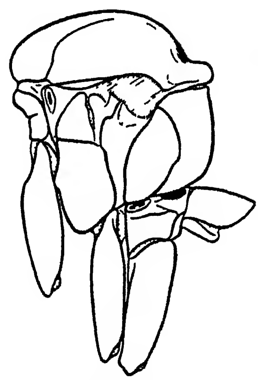
1 SCIARA



2 BOLITOPHILA

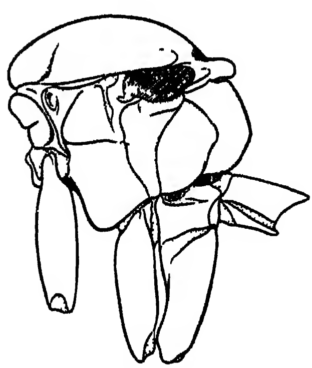


3 SYMMERUS

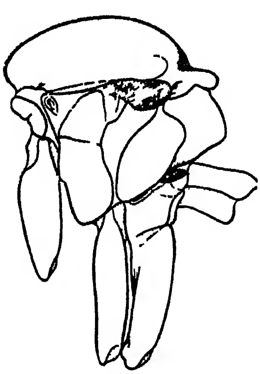


4 PALAEOPLATYURA

5 DIADOCIDIA



6 APEMON



7 PLATYURA

appears to be a dorsal lobe of the katepisternum may in reality be the posterior lobe of the anepisternum. However, the pleurotergite has developed an anterior process which apparently divides the mesothoracic epimeron into two distinct portions. I suspect that what seems to be a larger metapleuron may be actually a fusion of the meron and the pleura.

Palaeoplatyura, figure 4, from the standpoint of venation, is more primitive than *Bolitophila*. However, a true meron is not visible. The meso-epimeron is also narrower ventrally. The indication of a prescutellar suture is more distinct in *Palaeoplatyura* than in *Bolitophila*.

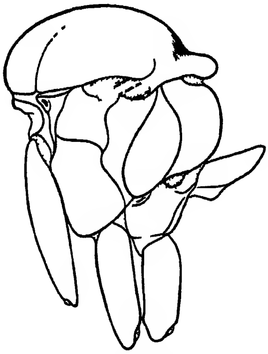
Diadocidia, figure 5, on the basis of thoracic sclerites, is more highly evolved than *Bolitophila*. The anepisternal cleft is not as deep, the mesoepimeron is narrowed ventrally and what I judge to be the remnant of the meron is apparently fused with the metapleura. The evidence of a prescutellar suture is very faint.

Apemon, figure 6, possesses several features indicating its primitiveness. The epimeron is relatively broad ventrally, the anepisternal cleft is deep, there is a small meron which is still attached to the eucoxa. However, as evidence of specialization, the thorax is depressed dorsoventrally. The venation, while primitive, is not as primitive as in *Palaeoplatyura*. The broader epimeron and the remnant of a meron would indicate that the genus is more primitive than *Palaeoplatyura*. In this case we have conflicting evidence as between the venational characters and thoracic sclerites.

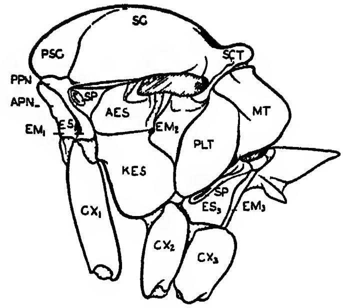
Platyura, figure 7, is clearly related to both *Palaeoplatyura* and *Apemon*. That it is more specialized than either is shown by the pronounced narrowing of the mes-epimeron. The anepisternal cleft is not as deep in this genus as it is in either *Palaeoplatyura* or *Apemon*. On the basis of venation, *Platyura* is more closely related to *Apemon* than to *Palaeoplatyura*. In *Platyura* there may be the culmination of a tendency of the meron to fuse back with the coxa. This tendency is indicated in *Palaeoplatyura*.

Macrocera, figure 8, in some ways appears intermediate in thoracic structure between *Palaeoplatyura* and *Platyura* However, on the basis of thoracic sclerites, it does not seem to be close to *Apemon* Indications of specialization are the sinuous mesopleural suture, the ventrally narrowed epimeron, the absence of the cleft in the anepisternum. The primitiveness is indicated by the lack of dorso-ventral depression.

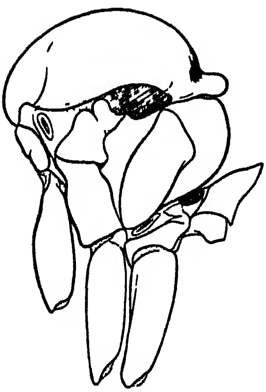
Fenderomyia, figure 9, on the basis of venation, is more primitive than Macrocera. The base of media is indicated as continuing from the wing base to the base of what has normally been considered to be the M-Cu crossvein. This form would seem to support the contention that media may possess three distinct branches in this group. Evidence of specialization is shown by the dorso-ventral depression of the thorax. Even more important is the reduction of the mesoepimeron. Whether the small triangular area above the base of the mesothoracic coxa is the remnant of the epimeron or a meron is open to question. I am inclined to the former view.



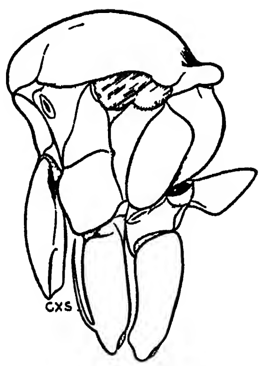
8 MACROCERA



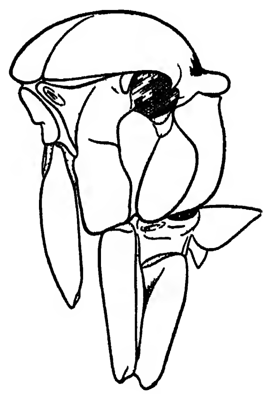
9 FENDEROMYIA



10 POLYLEPTA



11 MYCOMYIA



12 LEIA

13. COELOSIA

14 BOLETINA

Polyepta, figure 10, shows characters similar to those of *Platyura*. It is more specialized than *Platyura*, as is shown by the narrowed epimeron and the smaller post pronotum. A small area in connection with the coxa would seem to be similar to the structure considered to be the meron.

Mycomyia, figure 11, on the basis of venation, would be considered fairly close to Polylepta. From the study of thoracic structures it is evident that a significant change has occurred. The katepisternum is reduced in size. This condition is universal in the more specialized forms. On the basis of male hypopygial characters, Fisher considered that *Mycomyia* would be an annectant form between the Sciophilini and the Mycetophilini. This is borne out by the study of the pleura.

As previously indicated, Fisher considered that the Sciophilini, the Gnoristini, and the Leiini, while derived from a similar stock, were not evolved from one another. This view is supported by the present study in that, while on the basis of venation *Polylepta* is more primitive than the following genus, on the basis of certain thoracic characters the following genus is more primitive.

Leia, figure 12, possesses a broader meso-epimeron than *Polylepta*. Also, the post pronotum is more distinct in this genus. Another primitive character is the more distinct indication of a suture between the prescutum and the scutum of the mesonotum.

Coelosia, figure 13, is very similar to Leia on the basis of thoracic structure. The narrowed epimeron indicates that this genus is more specialized than Leia.

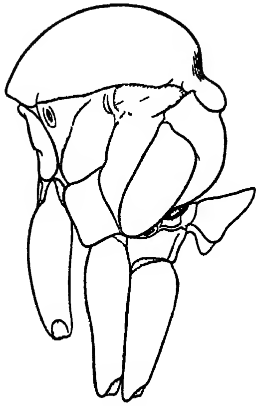
Boletina, figure 14, is closely related to both *Coelosia* and *Leia* on the basis of pleural characters. I consider it the most specialized of these genera on the basis of the reduction of the epimeron and postpronotum.

Of the Mycetophilini studied, *Phronia*, figure 15, seems to be the most primitive. The thorax is not markedly compressed dorso-ventrally, the epimeron is comparatively long, and is not as markedly oblique as in the other forms studied. In connection with this genus, the hexagonal shape of the anepisternum may be important as a distinguishing character. Another character which appears in Phronia and is developed more strongly in *Mycetophila*, *Opistholoba*, and *Sceptonia* is the groove in the lateral margin of the mesonotum caused by the pronotum pushing dorsally.

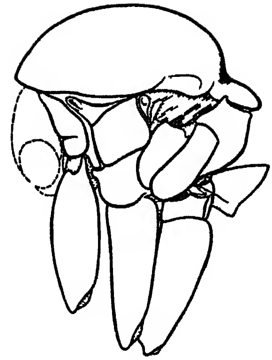
Allodia, figure 16, and *Exechia*, figure 17, are closely related. I consider that *Allodia* is more primitive. I do not consider that *Allodia* and *Exechia* were derived through *Phronia*, but arose from a separate stock.

Mycetophila, figure 18, as already indicated, is related to *Phronia*. It is certainly closely related to *Opistholoba*, figure 19. In an earlier paper, I considered that *Opistholoba* should be united with *Mycetophila*. However, the greater dorso-ventral thoracic depression and the more oblique epimeron lead me to consider that *Opistholoba* is distinct from Mycetophila.

The position of *Epicypta*, figure 20, is somewhat problematical. As regards dorso-ventral depression it is intermediate between *Opistho-*



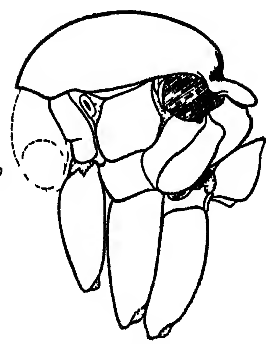
15 PHRONIA



16 ALLODIA

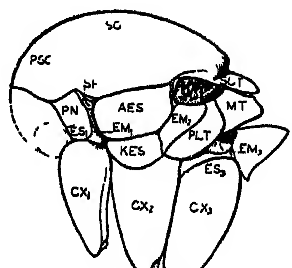
17 EXECHIA

18 MYCETOPHILA



19 OPISTHOLOBA

20 EPICYPTA



21 SCEPTONIA

loba and *Sceptonia*, figure 21. However, there are two characteristics that distinguish it from these two genera. The ventral surface of the meso-epimeron is *Epicypta* is flaired at the tip. This is not true in either *Opistholoba* or *Sceptonia*. Neither is it true in the species of *Mycetophila* studied. A further distinguishing characteristic is that the prothoracic epimeron in *Mycetophila*, *Opistholoba*, and *Sceptonia* is relatively large and lobe-like. In *Epicypta* this structure is only moderately developed. The present indications are that while *Epicypta* is more highly developed than *Mycetophila*, its ancestry must have been from a stock lower than the *Mycetophila* complex. While I formerly united this genus with Mycetophila, my present study indicates that *Epicypta* is distinct.

The final genus to be considered is *Sceptonia*, figure 21. This is clearly the most highly specialized of all of the genera studied. In it the dorso-ventral depression of the thorax is most marked. A character apparently of generic value is the dorsal development of the prothorax so that the lateral margin of the mesonotum is interrupted.

From this study it is evident that the shapes of the thoracic sclerites afford characters that are of value in both taxonomic and phylogenic studies. They can be used to some extent as generic characters.

Based on the data presented in this paper it would seem possible to divide the family into two major groups based on the relative sizes of the anepisternum and the katepisternum. *Mycomyia* is considered to be the annectant form between the two major groups. In such a grouping, the Bolitophilinae, Ditomyiinae, Ceroplatinae, Diadocidinae, Macrocerinae and Sciophiliinae including the Gnoristini and the Leiini form one group and the Exechini and Mycetophilini another. It would seem that this would support Edwards' placing certain of the Mycetophilinae with the Sciophilinae.

Other characters of value in the taxonomy of this group include the cleft anepisternum as found in the more primitive groups, the narrowed epimeron and the dorso-ventral depression of the thorax. This last phenomenon causes a shifting of the epimeron, and the pleurotergum from a horizontal to a transverse position.

SUMMARY

The pleural sclerites of twenty-one genera of the Mycetophilidae are illustrated and comparisons made between the different forms.

On the basis of the study, it would appear that the group could be divided into two major divisions based on the relative sizes of the mesothoracic anepisternum and katepisternum.

The pleural sclerites of *Sciara* support the belief that members of this subfamily are sufficiently distinct as to be in a group by themselves. This is in agreement with various European workers. In the past, 1935, I have considered the Sciarinae to be a subfamily. I now recognize the group as a distinct family—the Sciaridae.

CONCLUSIONS

While it is admitted that insufficient genera have been studied, it is evident that the pleural sclerites are of value in classifying the Mycet-

ophilidae. It is hoped that this study will provoke sufficient interest to make a complete survey of the problem.

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A COMPARATIVE MORPHOLOGICAL STUDY OF THE PROTHORACIC GLANDULAR BANDS OF SOME LEPIDOPTEROUS LARVAE WITH SPECIAL REFERENCE TO THEIR INNERVATION[1]

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Very few papers deal with the prothoracic glandular bands of lepidopterous larvae Toyama (1902) described them in *Bombyx mori* under the name "hypostigmatic gland," and more recently Ke (1930) described the variations in the same species under the name "prothoracic glands" In the present paper descriptions of the gland and its innervation are given for thirteen other genera representing eight different families of the order.

It is not yet proven that this is an endocrine gland, although the glandular appearance, absence of a duct and the type of innervation are suggestive of an endocrine function. It seems to the author [2] that the function of this gland would be worthy of study by insect physiologists.

The prothoracic glandular bands are symmertrically situated, one on each side of the prothoracic segment with the main part of the gland attached to the tracheae near the spiracle of the prothoracic segment. There may be four branches extending out from the main body of the gland: anterior, latero-ventral, latero-dorsal and posterior branches. The anterior branch, commonly quite elongated, extends towards the head and is commonly subdivided into an antero-dorsal and an antero-ventral branch, the two terminal ends commonly being attached to the integument on the ventral margin between the head and prothorax. The latero-ventral branch extends along innervating nerve fibers and is also commonly subdivided into two branches. The latero-dorsal branch is usually undivided and may be greatly reduced. A posterior branch was clearly recognizable in only one species (Bluina). The gland and its various branches are held in place by the associated tracheae and nerves shown in the figures

The antero-ventral branch of the gland is usually associated with a ventral nerve of the suboesophageal ganglion. The latero-ventral branches are associated with the median nerve from the prothoracic ganglion. The posterior branch is commonly penetrated by a nerve from the interganglionic connective between the prothoracic and mesothoracic ganglia, and also by one of the ventral nerves from the

[1]This research was carried out in the Division of Entomology, Sun Yatsen University, China, in 1938. The author is indebted to Dr. A. G. Richards, of the Division of Entomology and Economic Zoology, University of Minnesota, for reading this manuscript.

[2]This paper was originally submitted for publication in China in 1938, but the Japanese invasion prevented its appearance. Since the above was written two experimental papers have been published demonstrating that these are indeed endocrine glands as Miss Lee and others had surmized —Ed

mesothoracic ganglion. As comparison of the various figures show, there is a tendency for a common pattern to the innervation but the details differ considerably from one example to another. Different species within one family are usually rather similar.

In most cases the glands are flattened, compact bodies arranged in a more or less band-like form. In a few cases the cells resemble a string of beads that are so loosely held together that they may be readily teased apart with needles These two types are referred to in the descriptions as band-like and bead-like.

The species treated are arranged roughly in sequence beginning with the most primitive representatives and extending to the more highly evolved groups. Current concepts of evolutionary development within the order Lepidoptera suggests that the relationships of the families treated in the present paper are not sufficiently linear to warrant any evolutionary deductions from the small number of species studied.

Fig. 1. *Cnidocampa flavescens* Butler (Limacodidae). The prothoracic glandular bands are bead-like in appearance. The elongated anterior branch (1.3 mm. long) is undivided, winds around the longitudinal trachea to the head, and is dilated at its end; one side of the dilated terminal end is attached to a nerve from the prothoracic ganglion, the other side is attached by a fiber to the integument on the boundary between head and thorax. The latero-dorsal branch is a single row of cells (1.3 mm. long) which parallels a small tracheal branch; a very short branch arises from the basal portion of this and extends latero-dorso-posteriorly. The short latero-ventral branch is associated with a relatively complex nerve plexus.

In this family a special pair of nerves arises from the anterior median part of the prothoracic ganglion and extend laterally to innervate the anterior branch of the gland. The median and posterior parts of the gland are innervated from a plexus which receives fibers from the median nerve of the prothoracic ganglion, the connective between the prothoracic and mesothoracic ganglia and several ventral nerves from the mesothoracic ganglion.

Fig. 2. *Parasa* sp. (Limacodidae). Essentially similar to the preceding both in structure and innervation.

Fig. 3. *Clanis minuscula* Butler (Psychidae). A flat, broad band with a sickle-like bifurcation at the anterior end, and tapering latero-dorsal and latero-ventral branches. Total length about 1 mm. · The anterior branch is innervated by a median and ventral nerve from the suboesophageal ganglion plus a ventral nerve from the prothoracic ganglion; one nerve from this group runs posteriorly along the anterior branch of the gland. The posterior part of the gland is innervated by fibers coming from both the median nerve of the prothoracic ganglion and ventral nerves from the mesothoracic ganglion.

Fig. 4. *Marumba* sp. (Sphingidae). Bead-like glands composed of chain of cells. The anterior, rather convoluted, branch divides and then the ends fuse near their point of innervation. The lateral and posterior branches form a network at the base of the anterior branch and cannot be differentiated into branches to be homologized with those recorded for the other species. The anterior branch is innervated only from the

ventral nerve of the suboesophageal ganglion. The more posterior network is innervated with fibers from the median nerve of the prothoracic ganglion and nerves from the interganglionic connective and mesothoracic ganglion.

Fig. 5. *Schoenobius bipunctifer* Walker (Pyralidae). A small, relatively simple band only about 0.6 mm. long. The dilated end of the anterior branch is associated with a ventral nerve from the suboesophageal ganglion and attached to the integument by a fine fiber. The slender latero-ventral branch is associated with a median nerve from the prothoracic ganglion and a ventral nerve from the mesothoracic ganglion.

Fig. 6. *Chilo simplex* Butler (Pyralidae). This species shows the simplest structure of all the species studied. The vase-like silhouette can be differentiated into antero-dorsal, antero-ventral, latero-dorsal and latero-ventral branches. The total length is about 0.6 mm. The anterior branch is innervated from a ventral nerve of the suboesophageal ganglion; the posterior part from a median nerve from prothoracic ganglion.

Fig. 7. *Liparis dispar* Linn. (Liparidae). A band-like gland. The elongated anterior branch (about 1.8 mm.) is undivided but expanded at its end. The latero-dorsal branch has an anteriorly directed prong. The latero-ventral branch forms a ring of cells along one of the nerves. The anterior branch is innervated by ventral nerves from both the suboesophageal and prothoracic ganglia. The latero-ventral branch receives nerves from the median nerve from the prothoracic ganglion, a nerve arising from the interganglionic connective and another from the mesothoracic ganglion. The latero-dorsal branch is innervated by fibers from the mesothoracic nerve.

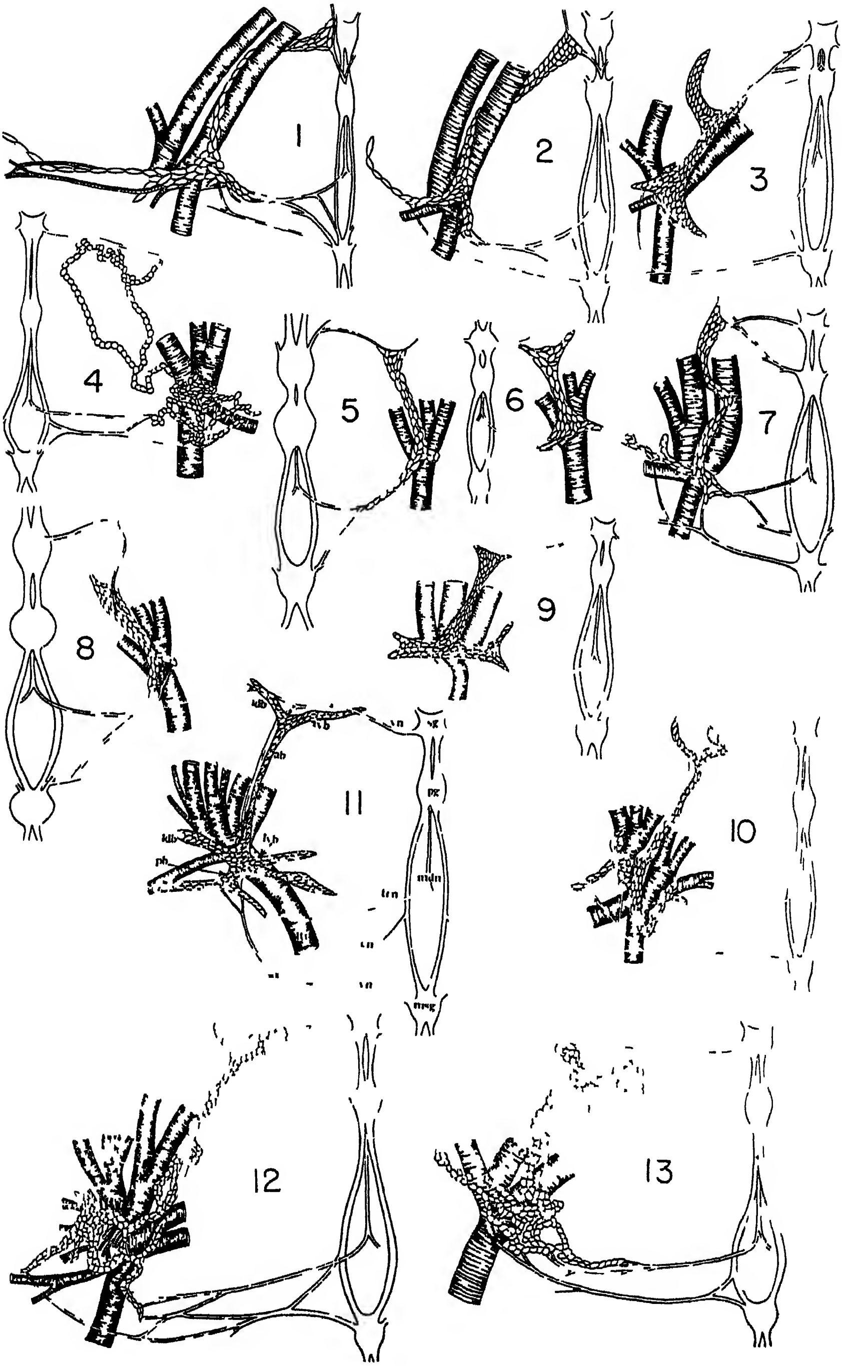
Fig. 8. *Sesamia inferens* Walker (Phalaenidae). A band-like gland which in silhouette somewhat resembles a human leg. The undivided anterior branch is only 0.6 mm. long. The latero-ventral and latero-

EXPLANATION OF PLATE I

Fig. 1. The prothoracic glandular band of *Cnidocampa flavescens*. Fig. 2. The prothoracic glandular band of *Parasa* sp. Fig. 3. The prothoracic glandular band of *Clania minuscula* Fig. 4. The prothoracic glandular band of *Marumba* sp. Fig. 5. The prothoracic glandular band of *Schoenobius bipunctifer*. Fig. 6. The prothoracic glandular band of *Chilo simplex*. Fig. 7. The prothoracic glandular band of *Liparis dispar*. Fig. 8. The prothoracic glandular band of *Sesamia inferens*. Fig. 9. The prothoracic glandular band of *Eligma narcissus*. Fig. 10. The prothoracic glandular band of *Dendrolimus spectabilis*. Fig. 11. The prothoracic glandular band of *Bluina idiota*. Fig. 12. The prothoracic glandular band of *Lebeda nobilis*. Fig. 13. The prothoracic glandular band of *Saturnia pyratarum*.

EXPLANATION OF ABBREVIATIONS

ab . .	anterior branch.	mdn. . .	median nerve.
adb . .	antero-dorsal branch.	msg . .	mesothoracic glanglion.
avb	antero-ventral branch.	pb...	..posterior branch.
cn . .	connective nerve.	pg.	prothoracic ganglion.
ldb....	latero-dorsal branch.	sg	suboesophageal ganglion.
ltr .	lateral longitudinal trachael trunk.	trn . . .	transverse nerve.
lvb. . .	latero-ventral branch.	vn. .	ventral nerve.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dorsal branches are both short. The anterior branch is innervated by a ventral nerve from the suboesophageal ganglion. The posterior parts of the gland are innervated by fibers from the median nerve of the prothoracic ganglion and from the ventral nerve of the mesothoracic ganglion.

Fig. 9. *Eligma narcissus* Cramer (Phalaenidae). A band-like gland in the shape of an inverted "T". The unbranched anterior branch is about 0.9 mm. long and expanded at its tip. The latero-dorsal and latero-ventral branches form a continuous transverse band about 0.8 mm. long with each branch bifurcated near the tip. The innervation is fundamentally the same as in *Sesamia.*

Fig. 10. *Dendrolimus spectabilis* Walker (Lasiocampidae). The band-like gland of this species is the simplest of the three species of this family examined. The anterior branch tapers somewhat to its bifurcation into antero-dorsal and antero-ventral branches. The latero-dorsal and latero-ventral branches are both bifurcated. The anterior branch is innervated from the suboesophageal ganglion. The posterior parts of the gland are innervated only from the median nerve of the prothoracic ganglion and the ventral nerve of the mesothoracic ganglion.

Fig. 11. *Bluina idiota* Graes. (Lasiocampidae). Species of this family show much more elaborate band-like glands. The elongated anterior branch (about 1.8 mm.) is bifurcated at the tip to form antero-ventral and antero-dorsal branches, both of which are attached at their ends to the integment between the head and prothorax. The latero-dorsal branch is single and measures about 0.5 mm. long. The latero-ventral branch bifurcates near its base to give rise to one free branch and one branch paralleling the transverse nerve. A posterior branch is present [3] and bifurcated to give dorsal and ventral lobes which together are about 0.8 mm. long. The anterior branch is innervated from the suboesophageal ganglion, the nerve dividing to innervate the anterior lobe and to send a nerve back to the main part of the gland. The posterior parts of the gland are innervated from the usual three sources, viz. the median nerve of the prothoracic ganglion, a nerve from the interganglionic connective and a ventral nerve from the mesothoracic ganglion.

Fig. 12. *Lebeda nobilis* Walker (Lasiocampidae). The details of the bandlike gland of this species are the most complicated of those of any species studied. The elongated anterior branch (about 2 mm. long) branches near its base, the two halves soon coming together again and fusing to form a ring; the anterior branch then follows a convoluted path anteriorly and finally divides into antero-dorsal and antero-ventral branches. The main part of the gland forms a large ring from which the branched latero-dorsal and latero-ventral branches arise. The posterior branch seems to be absent. The anterior branch is innervated from both the suboesophageal and prothoracic ganglia with nerves

[3]Since this posterior branch was found in no other species one could argue that its dorsal and ventral parts really are subdivisions of the latero-dorsal and latero-ventral branches with the separation extending all the way to the main body of the gland. For descriptive purposes the author refers to it as a separate posterior branch without meaning to imply an absence of homology.

extending posteriorly along it. The posterior part of the gland is innervated from a complex plexus the fibers of which originate from the same three sources as in the preceding species.

Fig. 13. *Saturnia pyratarum* Westwood (Saturniidae). A long convoluted bead-like gland. The anterior branch divides into relatively massive antero-dorsal and antero-ventral branches. The basal part of the gland forms a network with dorsal and ventral extensions that may be the same as the latero-dorsal and latero-ventral branches of the other species. The anterior branch is innervated from the suboesophageal ganglion. The posterior part of the gland is innervated from same three sources as in the last species.

SUMMARY

1. All lepidopterous larvae examined have prothoracic glandular bands in the vicinity of the prothoracic spiracles. These may be either band-like or bead-like strings of cells. From the main body of the gland there arises several branches; an anterior branch, a latero-dorsal branch, a latero-ventral branch, and sometimes a posterior branch.

2. Details of structure are diverse but species of the same family tend to be more similar than those of different families.

3. The most remarkable feature found was that the extensive innervation is highly diverse. In most cases the gland receives fibers from the suboesophageal, prothoracic and mesothoracic ganglia but the details are more or less different for all species studied.

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DESCRIPTIONS OF THE LARVAE OF SOME RUTELINE BEETLES WITH KEYS TO TRIBES AND SPECIES

(Scarabaeidae)[1]

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The subfamily Rutelinae reaches its greatest development in the neotropical region where the group is represented by 5 of the 6 known tribes (Blackwelder, 1944). In the United States and Canada only the two tribes Anomalini and Rutelini are represented but there is always the possibility that larvae of some species belonging to another tribe may be introduced as were larvae of the Japanese beetle, *Popillia japonica* Newman, and the oriental beetle, *Anomala orientalis* (Waterhouse), both belonging to the tribe Anomalini. The injurious Chinese rose beetle, *Adoretus sinicus* Burmeister, is now well established in the Hawaiian Islands and from there might be carried to our west coast.

A recent collecting trip to west Texas, Arizona, and California resulted in the discovery of the larvae of *Paracotalpa* (*Pocalta*) *ursina ursina* (Horn) and of *Plusiotis woodi* Horn, both of which are described in this paper. Larvae of *Adoretus sinicus* Burm., secured through the kindness of Walter Carter, and a reared larva of *Macraspis lucida* (01.), from Costa Rica, furnished by van Emdem, were also studied. The larvae of 14 species of the tribe Anomalini and of 3 species of the tribe Rutelini have been described previously by the writer and the literature on the contributions of other workers has been reviewed (Ritcher 1943 and 1945).

Subfamily **Rutelinae**

Larvae of the subfamily Rutelinae may be distinguished from other scarabaeid larvae by the following combination of characters: Mandible with a ventral, oval, stridulatory structure consisting of a number of transverse ridges. Maxilla with a row of anteriorly directed, sharp pointed, stridulatory teeth. Lacinia of maxilla with 1, 2 or 3 unci; if with 2 unci then the two are equal in size. Haptomerum of epipharynx with 2 or more prominent heli in a transverse row or with a raised mound- or beak-like process behind which are grouped 15 or more prominent spine-like setae not arranged in a definite transverse row. Epipharynx without proplegmata; plegmata present or absent. Dorsa of abdominal segments 9 and 10 never fused together. Raster with or without palidia. Anal slit transverse, slightly curved. Claws each bearing 2 setae.

[1]The investigation reported in this paper is in connection with a project of the Kentucky Agricultural Experiment Station and is published by permission of the Director.

KEY TO TRIBES OF THE SUBFAMILY RUTELINAE
BASED ON CHARACTERS OF THE LARVAE

1. Last antennal segment with 2 or more dorsal, sensory spots (figs. 1 and 3). Haptomerum of epipharynx with a group of 15 or more prominent, spine-like setae (figs. 14, 15, and 18). Plegmata present or absent. Palidia, if present, polystichous, extending across lower anal lip (figs. 23 and 24), tribe **Rutelini**
   Last antennal segment with a single, dorsal sensory spot (fig. 17). Haptomerum of epipharynx with a transverse row of 3 or more heli. Plegmata present. Palidia, if present, monostichous, not extending across lower anal lip (fig. 19) 2
2. Haptomerum of epipharynx with a transverse row of three (rarely 2 or 4) prominent heli. Palidia present, monostichous (fig. 19). Maxillary stridulatory area with 4 to 7 sharp recurved teeth. Lacinia of maxilla with 2 unci .... tribe **Anomalini**
   Haptomerum of epipharynx with a dense transverse row of 6 to 9 heli (fig. 16). Raster with a subtriangular teges of hamate setae; palidia absent (fig. 22). Maxillary stridulatory area with 8 or more sharp recurved teeth. Lacinia of maxilla with 3 unci (fig. 11) .... tribe **Adoretini**

KEY TO SPECIES OF THE TRIBE RUTELINI
BASED ON CHARACTERS OF THE LARVAE

1. Venter of last abdominal segment with a teges (figs. 20 and 21) 2
   Venter of last abdominal segment with 2 palidia each composed of a patch of medianly directed setae; palidia (and septula) extending longitudinally across the lower anal lip (figs. 23 and 24) 5
2. Head rather densely covered with setae (fig. 1). Haptomerum of epipharynx with a beak-like process (fig. 15). Haptolachus with a small, spine-like sclerotized plate (fig. 15). Maxillary stridulatory area with from 4 to 6 sharp teeth (fig. 10). Claws at least moderately long (figs. 7 and 8) 3
   Head sparsely covered with setae (fig. 3). Haptomerum of epipharynx elevated but not beak-like (figs. 14 and 18). Haptolachus incomplete; sclerotized plate absent (figs. 14 and 18). Maxillary stridulatory area with from 8 to 14 sharp teeth (fig. 9). Claws short (figs. 12 and 13) 4
3. Labrum bearing 2 prominent, transverse, crescent-shaped ridges (fig. 1). Spiracles of abdominal segments 7 and 8 larger than spiracles of abdominal segments 1 to 6 .... **Paracotalpa ursina ursina**
   Labrum without prominent ridges. Spiracles of abdominal segments 7 and 8 smaller than those of abdominal segments 1 to 6 .... **Cotalpa lanigera**
4. Labrum (and epipharynx) much wider than long, lateral margins not angulate. Epipharynx without epizygum (fig. 18) .... **Pelidnota punctata**
   Labrum only slightly wider than long, lateral margins angulate (fig. 3). Epipharynx with epizygum (fig. 14) .... **Plusiotis woodi**
5. Left mandible with 2 scissorial teeth. Epipharynx with plegmata present but rather inconspicuous. Venter of last abdominal segment with a prominent septula between the polystichous palidia, anterior to the lower anal lip (fig. 23) .... **Parastasia brevipes**
   Left mandible with 3 scissorial teeth (fig. 2). Epipharynx without plegmata. Venter of last abdominal segment with septula vague between palidia, anterior to the lower anal lip (fig. 24) .... **Macraspis lucida**

Paracotalpa ursina ursina (Horn), Third-stage Larva

Figs. 1, 5, 7, 8, 10, 15 and 20

Description based on the following material:

1. Four, third-stage larvae and 5 cast skins of third-stage larvae collected February 20, 1946, above Tessla, California, in Corral Hollow, by William Barr, Ray Smith, J. W. McSwain and the writer. The third-stage larvae were found from 6 to 12 inches deep in the soil

beneath *Artemesia* bushes and 3 of the larvae were feeding on the larger roots. The cast larval skins were found in pupal cells from 8 to 10 inches deep in the soil. Seventeen adult beetles were collected at varying depths ranging from close to the pupal cells to within 1 or 2 inches of the surface.

2. Three, third-stage larvae reared by the writer in August, 1946, from eggs laid by the above adults. No. 46-7E.

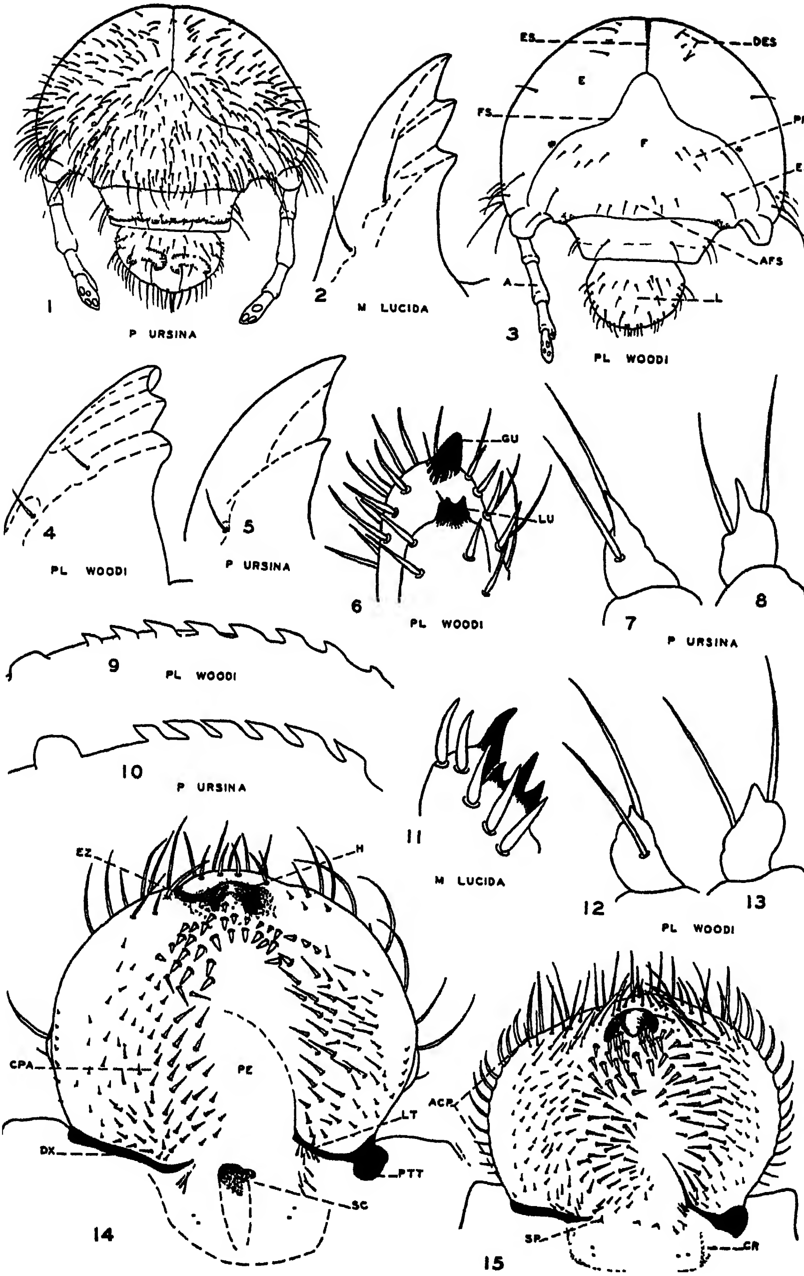
Maximum width of head capsule of third-stage larva 4.8 to 5.8 mm. Surface of cranium smooth, yellowish-brown, and rather uniformly covered with numerous setae (fig. 1). Clypeus with a prominent transverse ridge. Labrum wider than long and bearing 2 prominent, transverse, crescent-shaped ridges (fig. 1). Epipharynx (fig. 15) slightly wider than long. Haptomerum with a beak-like process behind which is a group of about 30 spine-like setae. Heli absent. Epizygum and zygum absent. Chaetoparia with almost no sensilla among the chaetae. Proplegmata and plegmata absent. Haptolachus complete with a small spine-like sclerotized plate adjacent to the dexiotorma and 2 median sense cones. Each mandible (fig. 5) with a blade-like portion anterior to the scissorial notch and a single, small, scissorial tooth posterior to the notch. Lacinia of maxilla with 2 unci which are alike in size and shape. Maxillary stridulatory area consisting of 5 or 6 sharp pointed, anteriorly directed, recurved teeth and a prominent distal, truncate process (fig. 10). Last antennal segment with 3 to 5 round to oval, dorsal, sensory spots (fig. 1).

Thoracic spiracles ranging from .41 to .52 mm. in length and from .267 to .28 mm. in width. Respiratory plate with a maximum of about 17 to 22 round to oval "holes" along any diameter. "Holes" not in definite rows. Distance between the two lobes of the respiratory plate equal to or only slightly less than the dorsoventral diameter of the bulla. Thoracic spiracles and spiracles of abdominal segments 2 to 6 inclusive very similar in size; spiracles of first abdominal segment noticeably smaller, those of abdominal segments 7 and 8 noticeably larger.

EXPLANATION OF PLATE I

Fig. 1. *Paracotalpa ursina ursina* (Horn). Head, dorsal view. Fig. 2. *Macraspis lucida* (01.). Scissorial area of left mandible, dorsal view. Fig. 3. *Plusiotis woodi* Horn. Head, dorsal view. A—antenna. AFS—anterior frontal setae. DES—dorsoepicranial setae. E—epicranium. EFS—exterior frontal setae. ES—epicranial stem. F—frons. FS—frontal suture. L—labrum. PFS—posterior frontal setae. Fig. 4. *Plusiotis woodi* Horn. Scissorial area of left mandible, dorsal view. Fig. 5. *Paracotalpa ursina ursina* (Horn). Scissorial area of left mandible, dorsal view. Fig. 6. *Plusiotis woodi* Horn. Distal part of left maxilla. GU—uncus of galea. LU—unci of lacinia. Fig. 7. *Paracotalpa ursina ursina* (Horn). Claw of left mesothoracic leg, side view. Fig. 8. *Paracotalpa ursina ursina* (Horn). Claw of left mesothoracic leg, dorsal view. Fig. 9. *Plusiotis woodi* Horn. Maxillary stridulatory area. Fig. 10. *Paracotalpa ursina ursina* (Horn). Maxillary stridulatory area. Fig. 11. *Adoretus sinicus* Burm. Distal part of left maxilla. Fig. 12. *Plusiotis woodi* Horn. Claw of left mesothoracic leg, side view. Fig. 13. *Plusiotis woodi* Horn. Claw of left mesothoracic leg, dorsal view. Fig. 14. *Plusiotis woodi* Horn. Epipharynx. CPA—Chaetoparia. DX—dexiotorma. EX—epizygum. H—haptomerum. LT—laeotorma. PE—pedium. PTT—pternotorma. SC—sense cone. Fig. 15. *Paracotalpa ursina ursina* (Horn). Epipharynx. ACP—acanthoparia. CR—crepis. SP—sclerotized plate.

PLATE I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Dorsum of seventh abdominal segment with 2 vague annulets, a prescutum and a scutum. Scutum with a dense covering of short, stout setae among which is a posterior transverse row of long setae. Prescutum with a sparse transverse band of long and short setae. Dorsa of abdominal segments 8 and 9 each with 2 well separated, sparsely-set, transverse bands of long and short setae. Dorsum of tenth abdominal segment with a rather conspicuous sclerotized, dorsal impressed line. Dorsal impressed line emarginate anteriorly. Venter of tenth abdominal segment without palidia (fig. 20). Teges consisting of a transverse patch of from 34 to 38 fairly short hamate setae with curved tips. Lower anal lip covered with similar hamate setae and with a caudal fringe of 17 to 38 long, cylindrical setae. Claws (figs. 7 and 8) sharp-pointed, each bearing 2 setae. Claws of metathoracic legs slightly shorter than those of mesothoracic legs; claws of mesothoracic legs shorter than those of prothoracic legs.

Plusiotis woodi Horn, Third-stage larva

Figs. 3, 4, 6, 9, 12, 14 and 21

Description based on the following material:

Two third-stage larvae reared from two second-stage larvae collected January 29, 1946, in the Davis Mountains, north of Ft. Davis, Texas, by the writer in an area suggested by H. A. Scullen of Oregon State College. The larvae were dug from rich soil and debris at the base of a walnut tree in a stream bed. Remains of 10 adults were found in the surface debris.

Maximum width of head capsule of third-stage larva 6.95 to 7.25 mm. Surface of cranium smooth, reddish-brown; labrium, clypeus and anterior half of frons reddish-black. Frons (fig. 3) bearing on each side, a patch of 4 or 5 posterior frontal setae, a single exterior frontal seta, 3 or 4 anterior frontal setae, and a single seta in each anterior frontal angle. Dorsepicranial setae 3 or 4 on each side. Labrum (fig. 3) slightly wider than long, nearly symmetrical. Epipharynx (fig. 14) with an epizygum and a raised haptomeral process behind which is a group of about 30 stout, spine-like setae. Chaetoparia with a few sensilla among the chaetae. Acanthoparia poorly developed. Plegmata and proplegmata absent. Haptolachus incomplete. Sclerotized plate absent. Left mandible (fig. 4) with 2 scissorial teeth anterior to the scissorial notch and a single scissorial tooth posterior to the same notch. Right mandible with only a single scissorial tooth anterior to the scissorial notch. Lacinia of

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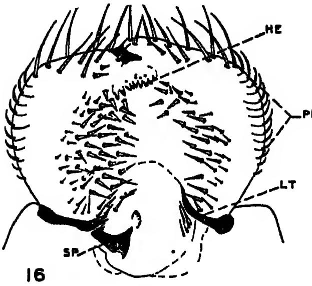
EXPLANATION OF PLATE II

Fig. 16. *Adoretus sinicus* Burm. Epipharynx. H—helus. PL—plegmatium. LT—laeotorma. SP—sclerotized plate. Fig. 17. *Adoretus sinicus* Burm. Last antennal segment, dorsal view. DSS—dorsal sensory spot. Fig. 18. *Pelidnota punctata* (Linn.). Epipharynx. DX—dexiotorma. PE—pedium. Fig. 19. *Anomala orientalis* (Waterhouse). Venter of last abdominal segment. LAL—lower anal lip. PLA—palidium. S—septula. Fig. 20. *Paracotalpa ursina ursina* (Horn). Venter of last abdominal segment. Fig. 21. *Plusiotis woodi* Horn. Venter of last abdominal segment. Fig. 22. *Adoretus sinicus* Burm. Venter of last abdominal segment. T—teges. Fig. 23. *Parastasia brevipes* (Lec.). Venter of last abdominal segment. LAL—lower anal lip. PLA—palidium. S—septula. Fig. 24. *Macraspis lucida* (Ol.). Part of venter of last abdominal segment. S—septula.



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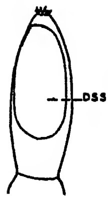
A SINICUS



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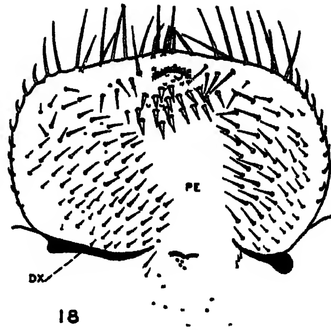
A SINICUS



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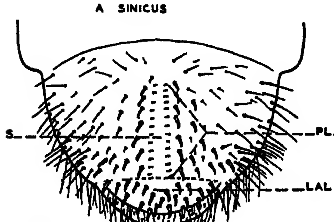
PEL PUNCTATA



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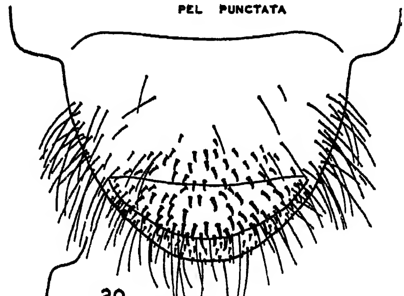
A ORIENTALIS



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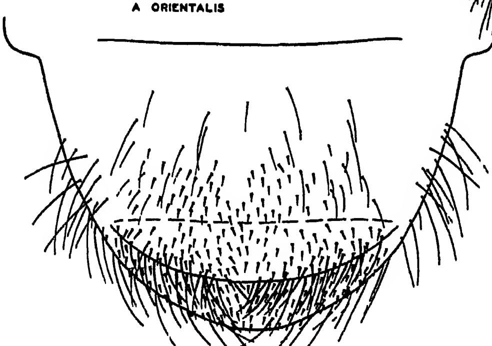
P URSINA



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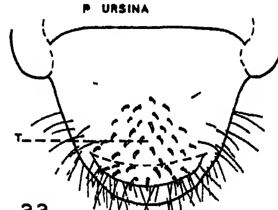
PL WOODI



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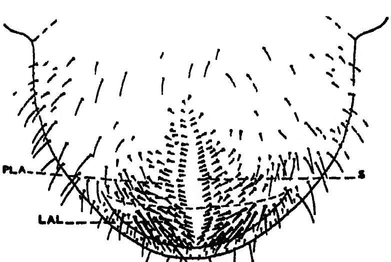
A SINICUS



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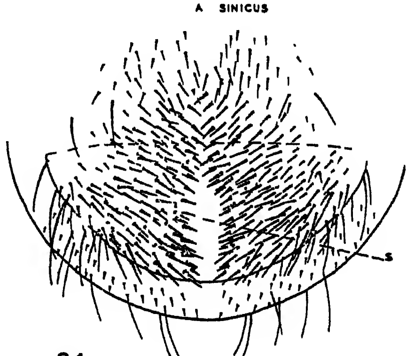
PAR. BREVIPES



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maxilla (fig. 6) with 2 terminal unci which are fused together at their bases; dorsal uncus with a single seta. Maxillary stridulatory area (fig. 9) consisting of a row of 8 or 9 sharp-pointed teeth and a wide, anterior, truncate process. Last antennal segment (fig. 3) with 4 or 5 anal, dorsal, sensory spots.

Thoracic spiracles ranging from .8 to .86 mm. in length and .56 to .62 mm. in width. Respiratory plate with a maximum of about 32 oval to round "holes" along any diameter. Distance between the two lobes of the respiratory place much less than the dorsoventral diameter of the bulla. Spiracles of abdominal segments 1 to 6 similar in size and smaller than spiracles of abdominal segments 7 and 8. Thoracic spiracles distinctly larger than any abdominal spiracles.

Dorsum of seventh abdominal segment with two vaguely defined annulets, a prescutum and a scutum. Prescutum with a transverse lens-shaped patch of short, stout setae interspersed caudally with a few long setae. Scutum with a sparsely set transverse row of long and short setae anterior to which are a few short, stout setae. Dorsa of abdominal segments 8 and 9 each with 2 widely separated, sparsely set transverse rows of long setae among which are a very few short setae. Dorsum of tenth abdominal segment on each side with a sparse covering of long setae and short stout setae; median longitudinal area bare. Dorsal impressed line absent. Venter of tenth abdominal segment (fig. 21) without palidia. Teges consisting of a transverse patch of 47 to 55 fairly short, stout setae. Lower anal lip clothed anteriorly with similar setae, posteriorly with a fringe of 62 to 71 stout cylindrical setae. Claws (figs. 12 and 13) short, each with 2 setae.

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NOTES ON NEARCTIC HEMEROBIIDAE, WITH DESCRIPTIONS OF TWO NEW SPECIES

(Neuroptera)

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In a collection of Neuroptera from the University of Kansas, studied through the kindness of R. H. Beamer, two new Hemerobiidae were found. One is a very pale Californian species of *Sympherobius*. The other, a species of *Hemerobius*, was previously represented in the collection of the United States National Museum and is evidently widespread and common in the Far West, but was formerly confused with *Hemerobius pacificus* Bks. Because of the many records of *pacificus* as a predator on mites and insects of economic importance, certain of these records apparently are applicable to the new form, and biological control studies may be clarified by the knowledge that *pacificus* as formerly treated in literature is actually a composite species. The standard reference work on the taxonomy of the Nearctic Hemerobiidae is that of Carpenter (1940),[1] and I have endeavored to give notes and illustrations that will be supplemental to those in his comprehensive paper.

Although many Hemerobiidae may be identified by characters of the wings and other entirely external structures, other species may be recognized only by means of the male terminalia. The terminalia may be best examined after removing the apical portion of the abdomen and treating it mildly with either a cold or hot solution of caustic potash. It is important that this treatment be mild; otherwise, essential features will be rendered too pale and weakly sclerotized for effective study. The finished preparations are preserved in glycerol within a glass capsule attached to the pin on which the specimen is mounted. In the case of specimens preserved in alcohol, treatment with potash is not so necessary. When examining minute preparations in small watch glasses, I have found that movement of the preparation, and consequent difficulty of study, is prevented by lightly sticking the preparation to a little vaseline or one of the common household ointments placed in the bottom of the watch glass before adding alcohol. The figures of Carpenter (1940) show the relationship of the parts of the terminalia, and his terminology has been used here.

Genus Hemerobius L.

Of the 13 Nearctic species of *Hemerobius*, all occur west of the Rocky Mountains (several in the East also).

[1]Carpenter, 1940, (Proc. Amer. Acad. Arts Sci. 74, no. 7: 194–253).

Hemerobius neadelphus,[2] new species
(Figures 1, 4, 6)

Male (*holotype*).—Of medium size for genus. Wings essentially as illustrated for allotype (fig 1); right front wing with 6 inner gradates, upper one connecting R_3 with R_2. b, upper 4 gradates somewhat more closely spaced than in allotype; left wing with 5 inner gradates; attachments of ends of crossvein beyond fork of Cu_1 variable in right and left wings.

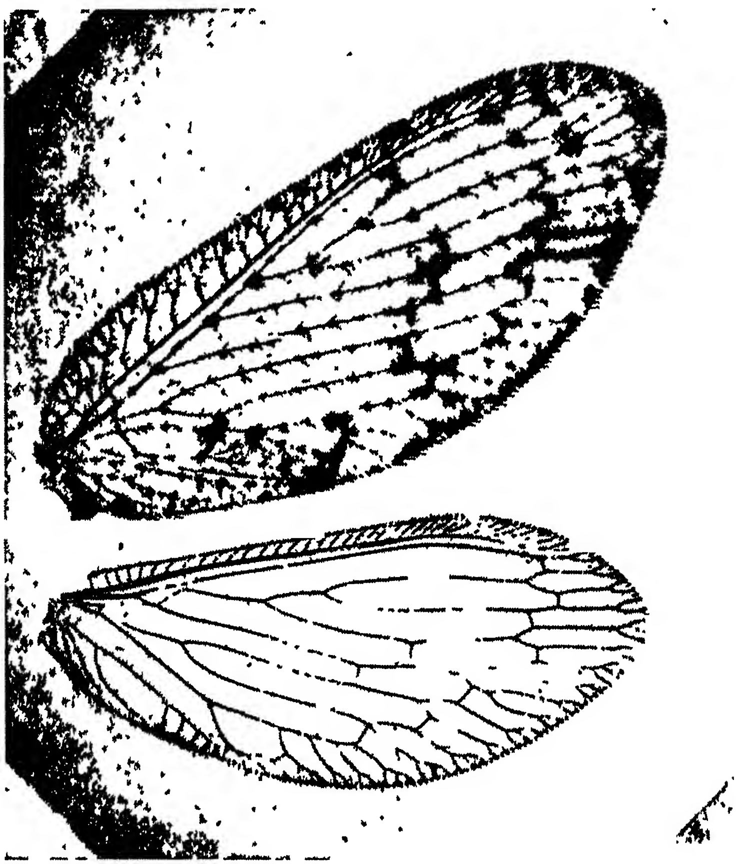

FIG. 1 *Hemerobius neadelphus*, new species, right wings of female allotype Length of front wing, 9.2 mm. Photographed by M L F. Forbert, U S. Department of Agriculture.

Terminalia (figs. 4–6): Tergum 9 unspecialized. Anal plate with 2 processes of subequal length, separating fork narrowly rounded; ventral process scarcely incurved in posteroventral view; dorsal process with

[2]From two Greek words meaning "new brother."

apex spinous, strongly recurved, much as in *pacificus*. Plates of aedeagus (fig. 5, aep) strongly curved, considerably enlarged in basal half, bridge of sternum 10 noticeably arcuate posteriorly.

Coloration: General body color pale brown; head and antennae pale, latter slightly darker on apical third; eyes black; thorax dark brown, a pale median longitudinal stripe of medium width; legs pale; wings marked with brown, less darkly than in allotype (fig. 1).

Measurements: Length of body, 5 mm.; of front wing, 7.6 mm.; width of front wing, 3.2 mm.

Female (*allotype*).—Agreeing with type in all important respects other than terminalia. Length of front wing ,9.2 mm., width, 3.4 mm.

The *paratypes* show that 5 is the normal of inner gradate veins. A few specimens have the dark wing markings lacking except for those on cubitus and the main stem of radius, and the body very pale except for brown lateral humeral stripes on the thorax. Wing length varies from 7 mm. (males from Utah and Yosemite National Park) to 9.2 mm. (females from Kaslo, B. C.). Wings of the Kaslo specimens are about 1 mm. longer than those from Yosemite National Park of the same sex.

Type locality. Kaslo, B. C.

Type. Male, United States National Museum, Type No. 58599, collected at type locality, on July 4, 1903, by R. P. Currie *Allotype* taken there by Mr. Currie on July 2, 1903.[3]

Paratypes. 18 males, 8 females, from the following localities:

British Columbia. Kaslo: 4 ♀♀, July 8, July 24, Aug. 4, Aug. 5; 5 ♂♂, July 2 (2), July 8, July 15, Aug. 5 (all Currie, 1903).

Oregon. Siskyou, Jackson Co.: ♂, July, 6, 1946, elev. 3000 ft., (Borys Malkin).

California. Oakland: ♂, May 29, 1924 (H. G. Dyar). Berkeley: ♂, "Collected on *Baccharalis pilularis* 7–10–18" (I. J. Condit). Page Mill Rd., Santa Clara Co.: ♂, June 4, 1947 (J. W. Tilden). Alhambra: ♂, February, 1918 (W. M. Davidson). Yosemite National Park: 4 ♀♀, 5 ♂♂, Aug. 1, 1940 (R. H. Beamer). La Jolla: ♂, July 13, 1941 (R. H. Beamer).

Utah. Logan: ♂, Sept 11, 1939 (Knowlton & Stains); ♂, Dec. 1, 1937 (L. L. Hansen).

Because of the lack of features known to distinguish females of *neadelphus* from those of *pacificus*, the only females included among the paratypes are those from Kaslo, B C, and Yosemite National Park, Calif, associated with males Paratypes will be deposited at the California Academy of Sciences, San Francisco, Calif, the Museum of Comparative Zoology, Cambridge, Mass, and at the University of Kansas, Lawrence, Kans.

H. neadelphus is distinguished from *pacificus*, with which it was formerly confused, by the following features of the male terminalia. The processes of the anal plate (figs. 2, 4) are separated by a narrowly rounded fork, rather than a broadly rounded, squarish interval; the ventral process of the anal plate is simple and scarcely incurved, rather

[3]This material was recorded by Currie, 1904 (Proc. Ent Soc. Wash 6: 85) as *pacificus* Also see "An insect-collecting trip to British Columbia" (ibid 6: 24–37, 1904), by the same author.

than strongly incurved (figs. 6, 7); the plates of the aedeagus are more swollen basally than those of *pacificus* and they are less widely separated where attached to the arcuate, instead of the practically straight, bridge of sternum 10 (figs. 3, 5). In both species the tips of the aedeagal plates may be widely or narrowly separated, depending on the condition and manipulation of the specimen. Judging from the males examined (*neadelphus*, 19; *pacificus*, 7), there is no appreciable variation in the above characters.

Aside from *pacificus*, the species most likely to be confused with *neadelphus*, because of prevalence or comparable features, are *conjunctus* Fitch (especially in British Columbia), *ovalis* Carp. and *stigmaterus* Fitch (see figs. 8–10). Other species are not likely to be confused with *neadelphus*, and several are relatively rare. It may be noted that the illustrations have been made to show the plates of the aedeagus in a single plane, though the plates of certain species extend ventrally much more than those of others. The plates of the various species may be compared more directly if all are studied in the same plane.

Carpenter (1940) treated *pallescens* Currie, 1904, and *discretus* Navas, 1917, as synonyms of *pacificus*. The Navas type, collected at Jemez, N. M., is not now available for study. In the light of present distribution records, however, the above synonymy of *discretus* appears correct. The possibility that *pallescens* may be the same as *neadelphus* poses a more critical problem, at present unsolvable. The type of *pallescens* is a large yellowish female, the front wing of which measures 10 mm., collected May 30, 1903, at Fieldbrook, Humboldt Co., Calif. Since both *pacificus* and *neadelphus* probably occur in that vicinity, the identity of *pallescens* can not further be clarified until characters separating females of those species are known, or until detailed information concerning the *Hemerobius* population at the type locality is available.

Records suggest that *neadelphus* may be more common than *pacificus* in California and other Pacific Coast States, though the latter is repre-

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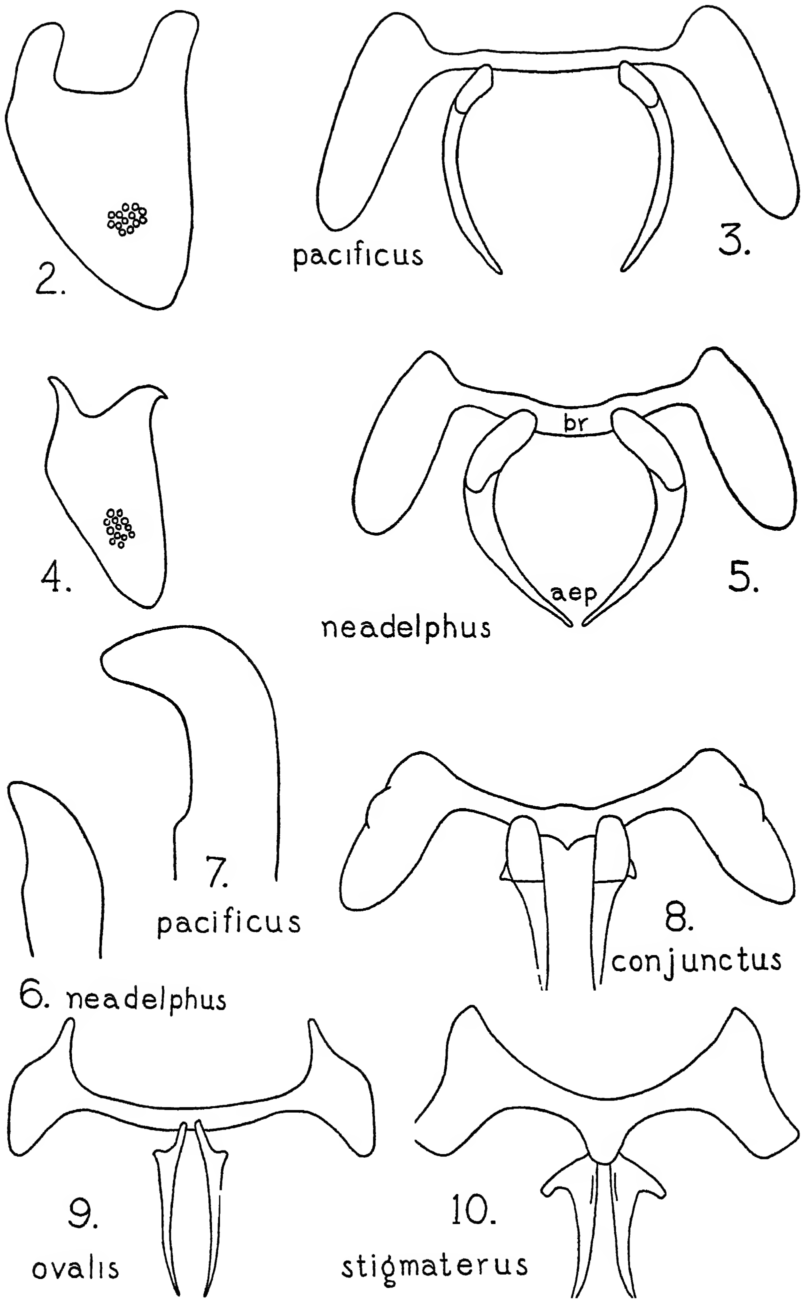
EXPLANATION OF PLATE I

(All drawings by the author.)

Fig. 2. *Hemerobius pacificus* Bks., male, lateral view of right anal plate. New Mexico (Transition Zone). Fig. 3. Same, *posterodorsal view* of sternum 10 and aedeagus. Same specimen as in fig. 2. Fig. 4. *H. neadephus*, male, same view as fig. 2. Yosemite Nat'l. Park, Calif. Fig. 5. Same, same view as fig. 3. Holotype. Fig. 6. Same, male, *posteroventral view* of ventral process of right anal plate. Logan, Utah. Fig. 7. *H. pacificus*, same view as fig. 6. Logan Utah. Fig. 8. *H. conjunctus conjunctus* Fitch, same view as fig. 3. Las Vegas, N. Mex. Fig. 9. *H. ovalis* Carp., same view as fig. 3. Logan, Utah. Fig. 10. *H. stigmaterus* Fitch, male, *posterior view* of sternum 10 and aedeagus. Lone Pine, Calif.

ABBREVIATIONS USED IN PLATES

ae—aedeagus.
aep—plates of aedeagus.
ap—anal plate.
br—bridge of 10th sternum.
MP—posterior branch of media.
p—process of anal plate.
pa—parameres.
pr—process of aedeagus.
rv—recurrent vein.
S9, S10—9th and 10th sterna.
T9—9th tergum.
x—next to lowest inner gradate vein.
y—MA-MP crossvein.
z—middle arm of parameres.


2.
pacificus
3.
4.
br
aep
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neadelphus
7.
pacificus
6. neadelphus
8.
conjunctus
9.
ovalis
10.
stigmaterus

sented by several specimens from New Mexico, where *neadelphus* is now unknown. The type locality of *pacificus* is Olympia, Wash. I have seen Californian males only from Lone Pine (Inyo County) and Cherry Valley (near Beaumont, Riverside County).

The male of *neadelphus* from Alhambra, Calif., bears data showing that it matured in February, 1918, from a larva reared on apple aphids and Cicadellidae: the egg was collected by W. M. Davidson on Jan. 26, 1918, from the previous season's foliage of an apple tree. Larvae of the closely related *Hemerobius pacificus* have often been recorded as predators of aphids, thrips, mites and other pests[4] and some of the records probably apply at least in part to *neadelphus*.

Genus **Sympherobius** Banks

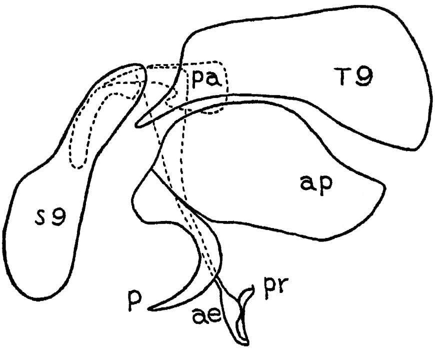
The new species here described, together with *perparvus* (McL.) and *killingtoni* Carp., comprise the known Nearctic members of what may be termed the "*perparvus group*." The outstanding feature of these species is that each anal plate of males bears a single process, not two or more processes as in other species. The parameres (figs. 18–23) are much alike. These species also agree in lacking a radial cross vein, though that character is not peculiar to them. Species with extremely narrow wings for the genus (*perparvus, beameri*) and with only moderately narrow wings (*killingtoni*) are included. Two Nearctic species of *Sympherobius*, *arizonicus* (Bks.) and *pictus* (Bks.), are known only from females, and they may be members of the group, though the shape and color markings of the wings readily distinguish them from *beameri*, n. sp.

Genitalic characters that I have found most useful are the process of the anal plate and the process of the aedeagus. The parameres are so small and delicate that few distinctions may be made in them except for the nonexpanded middle arms of *killingtoni*. Lateral views (figs. 21–23) are included mainly to show the close similarity of the three species in this respect. Certain differences that appear in the drawings, as the double or single line at the posterior margin of tergum 9 (figs. 12, 14, 16), are not considered important but rather to reflect the variable appearance of individual specimens. The aedeagus is a delicate structure of distinctive shape, somewhat loosely attached to

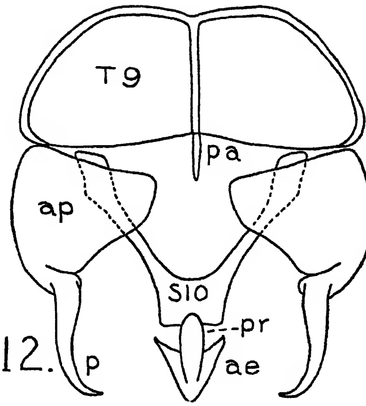
[4]The following are important references to *pacificus* as a predator:
Balduf, 1939 (The Bionomics of Entomophagous Insects, Pt. 2: 256–260).
Essig, 1926 (Insects of Western North America: 156–157).
Ewing, 1914 (Oreg. Agr. Expt. Sta. Bull. 121: 57).
Moznette, 1915 (Jour. Econ. Ent. 8: 350–354).
Quayle, 1912 (Calif. Agr. Expt. Stat. Bull. 234: 516–518); 1938 (Insects of Citrus and other Subtropical Fruits: 40–41).

EXPLANATION OF PLATE II

Fig. 11. *Sympherobius perparvus* (McL.), male, *lateral view* of apex of abdomen. Texas (Belfrage). (May be topotype, as Belfrage took type in Bosque Co., Tex.) Fig. 12. Same, *dorsal view* of apex of abdomen. Same specimen as in fig. 11. Fig. 13. *S. beameri*, new species, same view as fig. 11. Holotype. Fig. 14. Same, same view as fig. 12. Holotype. Fig. 15. *S. killingtoni* Carp., same view as fig. 11. Paratype, Williams, Ariz. Fig. 16. Same, same view as fig. 12. Same specimen as in fig. 15.



11. perparvus



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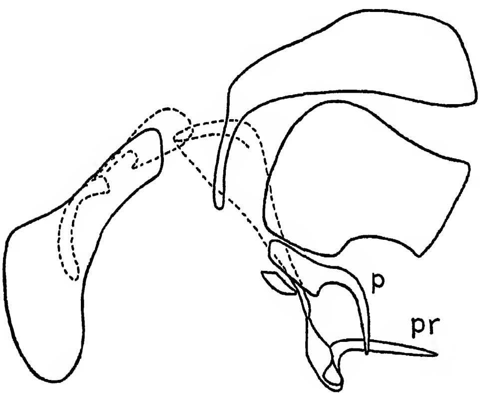
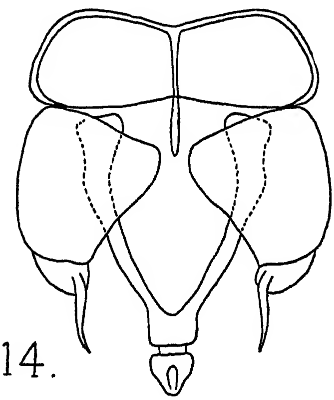


13. beameri



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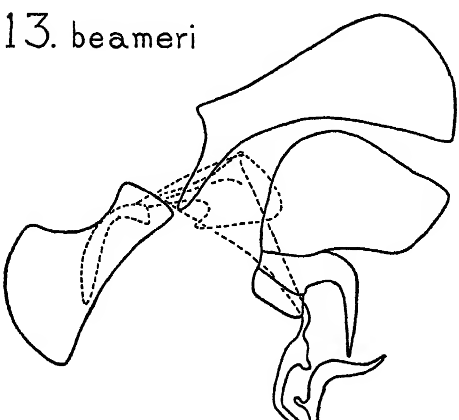
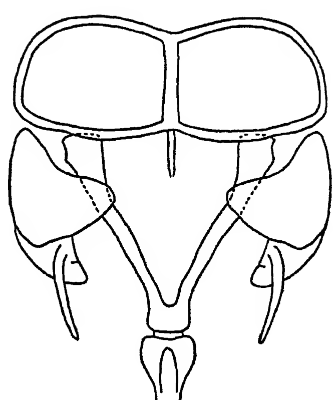


15. killingtoni



16.

the apex of sternum 10. For this reason the orientation of the aedeagus may differ if preparations are worn by excessive manipulation.

S. beameri shows closest relationship to *perparvus* in the wing shape and the shape of sternum 9 of the male, but more similarity to *killingtoni* in the form of the anal plate process. The three species of the *perparvus group* may be distinguished by the following key:

1. Front wing maculate, usually with more or less coalescing brown blotches, and with conspicuously and heavily brown margined gradate veins; front wing only moderately narrow for genus, the costal margin narrowed near distal end of subcosta to about one-half the greatest width; base of sternum 9 of male expanded (fig. 15); middle paramere arms not expanded (fig. 18)... **killingtoni**
   Front wing uniformly white, or ashy gray and maculate usually with well scattered blotches, gradates not margined, but may be darkened and often coincide with roundish or irregular brown or gray blotches; front wing decidedly narrow for genus (fig. 17), the costal field of more uniform width than above; base of sternum 9 of male not as above (figs. 11, 13); middle paramere arms expanded (figs. 19, 20)........................ 2
2. Front wing immaculate; distal half of male anal plate process practically straight (figs. 13, 14); process of aedeagus straight and erect........ **beameri**
   Front wing maculate with blotches; process of male anal plate conspicuously curved throughout its length in lateral view, moderately so in dorsal view (figs. 11, 12); process of aedeagus not straight and erect..... **perparvus**

Sympherobius beameri, new species

(Figures 13, 14, 17, 20, 23)

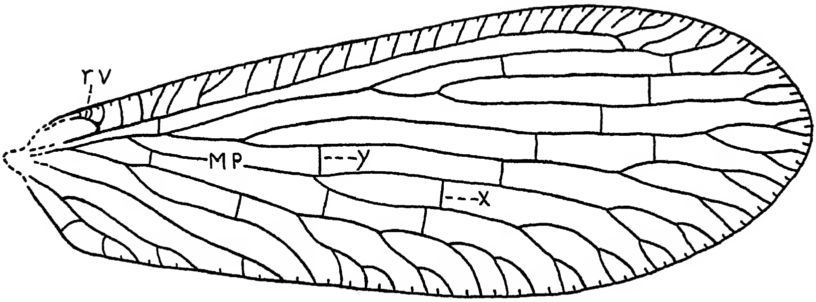
Male (*holotype*).—Small and unusually pale for genus. Front wing essentially as illustrated in paratype; in left wing the next to lowest inner gradate vein (fig. 17, x) only slightly nearer basal gradate than to next distal one above; in right wing next to lowest gradate nearer to one above than to basal gradate; in right wing MA-MP crossvein (fig. 17, y) briefly basad of fork of MP; recurrent vein (rv) and both gradate series weakly defined; radial crossvein absent. Hind wing slightly shorter than front wing.

Terminalia (figs. 13, 14, 20, 23): Tergum 9 with lateral extremity slender, noticeably elongate. Anal plate with posterior margin dorsad of process broadly concave; process single, apical half straight in lateral view, weakly incurved in dorsal view. Process of aedeagus erect, straight. Basal half of sternum 9 slender, scarcely expanded at point of tergal attachment. Parameres with tips of middle arms (fig. 20, z) conspicuously expanded.

Coloration: General body color pale brown; pronotum somewhat darker; basal half of antennae slightly darker than distal half; eyes black; legs pale clay yellow; wings uniformly ashy white, longitudinal veins bearing trichia but unspotted.

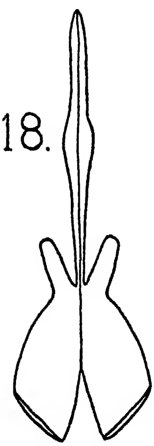
EXPLANATION OF PLATE III

Fig. 17. *Sympherobius beameri*, new species, male, right front wing. Length, 3.6 mm. Paratype. Fig. 18. *S. killingtoni* Carp., male, *posterodorsal view* of parameres. Hansen, Idaho. Fig. 19. *S. perparvus* (McL.), same view as fig. 18. Same specimen as in fig. 11. Fig. 20. *S. beameri*, same view as fig. 18. Holotype. Fig. 21. *S. killingtoni*, *lateral view* of parameres. Same specimen as in fig. 18. Fig. 22. *S. perparvus*, same view as fig. 21. Same specimen as in fig. 11. Fig. 23. *S. beameri*, same view as fig. 21. Holotype.



17. Sympherobius beameri

18.



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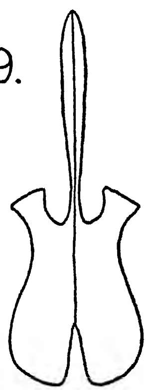
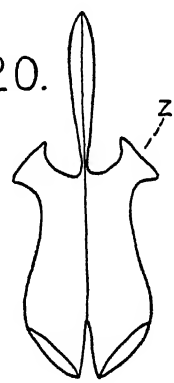
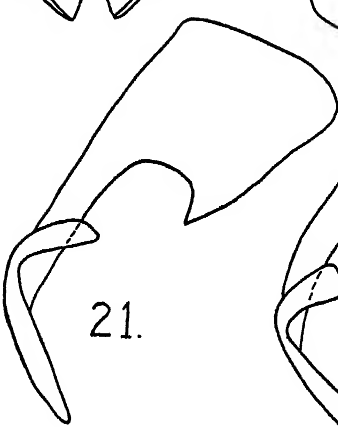
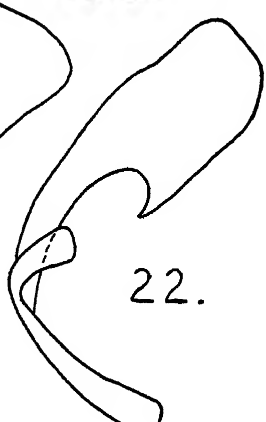


20.





21.



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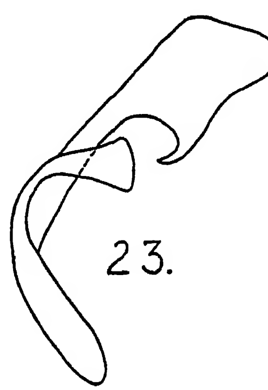

23.

killingtoni perparvus beameri

Measurements: Length of body, 3.5 mm.; of front wing, 3.6 mm.; width of front wing, 1.35 mm.

In addition to the type just described, there is one male paratype, the left front wing of which has the basal two inner gradates more separated than in the right wing (fig. 17). The gradates are also weakly darkened. Otherwise, there is full agreement with the type.

Type locality. Lake Tahoe, Calif.

Type. Male, University of Kansas, collected at type locality on Aug. 11, 1940, by R. H. Beamer.

Paratype. Male, United States National Museum, Type No. 58600, collected at Rosamond, Calif., on July 23, 1940, by D. E. Hardy.

The two localities are about 300 miles apart, one (Lake Tahoe) east of the high Sierras, the other (Rosamond) in the arid country of southern Kern Co., Calif., thus suggesting that *beameri* is probably widespread in California and Nevada.

A CLASSIFICATION OF NORTH AMERICAN CONOPIDAE

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In the course of determining several lots of North American Conopidae, it soon became evident that there were considerably more names than species Sixty-seven years age S. W. Williston, in his account of *Conops*, admonished that "the indiscriminate description of new species, is here especially to be deprecated; and, owing to the great individual variation of color, and the paucity of plastic characters, large collections will be essential, eventually, to a complete and satisfactory knowledge". Since Williston's advice has not been too well followed, the present paper is an attempt to clear up some of the difficulties and present a point of departure for future studies.

In a manner typical of many parasitic insects the species of Conopidae exhibit remarkable individual variation. This variability is not only sexual but includes many of the characters commonly utilized in defining species and even genera. Generic characters which may vary greatly are wing venation, ocelli, hairs, and length of palpi and proboscis. Specific characters of a variable nature are size, color, shape of antennae, and amount of pollen. For instance, in certain *Zodion* such as *obliquefasciatum*, Camras has recognized three phases: melanistic, rufous, and pollinose. Also, especially in *Physoconops* and *Physocephala*, boreal examples of a species tend to be smaller and darker, and the more austral specimens tend to be larger and more rufous than normally. Or these same tendencies may depend on the season.

All this specific variability has not been properly recognized in the past, with the result that too many names have been applied. Krober and M. C. Van Duzee have been especially liberal in this respect. Following their species concept this writer (1940, Psyche, 47.27–37) described from the West Indies several species which now should probably be regarded as synonyms of the species with which they were compared. After studying Holarctic Conopidae in some detail, this writer arrived at a much more conservative concept of species, which is followed in the present work.

In 1939 Bohart and MacSwain published an account of rearing over 100 specimens of *Physocephala* from one nest of a Bembecid wasp. On examining this single rearing they found variations enough to include five of Van Duzee's species. Their evidence is here utilized as criteria for evaluating other variations to which names have been assigned. Consequently many species are here synonymized. In almost every case where Bohart or Camras have examined the types and placed the names in synonymy, this writer had previously done so in manuscript. Therefore, although the types of Van Duzee, Krober, Bigot, and a few others were not studied, this writer feels justified in committing to synonymy many of the described species. Only in this way has it been possible to bring some workable order to the welter of names. Nevertheless, the present arrangement of species should be looked upon as tentative.

When habits, genitalia, etc. are studied, some of the relegated names may be raised to at least subspecific rank.

In the Conopidae the descrimination of species is complicated by distinct sexual dimorphism. The relative lengths of the antennal segments, the shape of the style, the length of the proboscis, and color may vary between the sexes and have led to much of the conflicting views on species limits. The more fundamental distinctions have been stated by Faulkner (1931).

The female has the fifth and seventh abdominal segments modified. Seven segments are distinctly visible and the eighth forms the tip of the abdomen. In all our genera (except *Sicus* and most *Myopa* the former herein excluded from the New World) the fifth segment is produced ventrally to a greater or less degree to form the structure termed by the

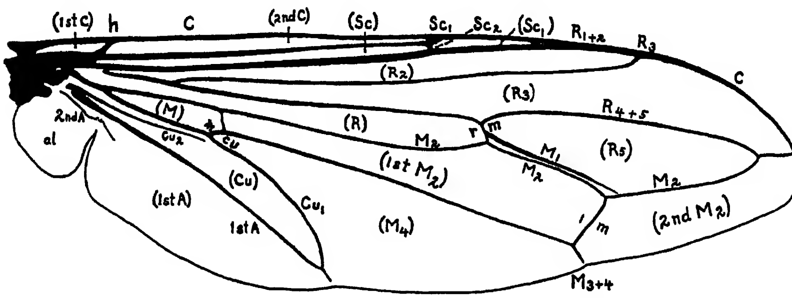

FIG. 1. Wing of *Physocephala tibialis* (Say). The system of nomenclature is that of Comstock-Needham (1918) emended by Tillyard (1919) and Alexander (1927, 1929). In addition a hitherto neglected vein is recognized as M_1 and is assumed to be homologous with the *vena spuria* of Syrphidae. The significant if more radical emendations proposed by Lameere (1922) and by Vignon and Séguy (1929, 1932) are not followed.

French writers apophase copulatrice, by Schiner 'unpaarige Organ', by Kröber 'Theca', by Szilady 'auffalenden Geschlechtdimorphismus', and by others the ventral or genital plate or process. In *Sicus* and many *Myopa* this structure is replaced by a tuft of hairs or bristles. In all our genera the seventh and eighth segments are prolonged in the shape of a shoe and curved to meet the genital plate in such a manner as to suggest a clasping organ. Both prolongations are lined with papillate pads, which are apparently modifications of the fifth, sixth, and seventh sternites.

The male tends to have a shorter abdomen with only six unmodified segments (five in Dalmanninae). The seventh and eighth segments are modified into a double cushion-shaped process underneath the fifth and sixth segments.

For the purpose of this paper the Neotropical species have been omitted. Since many more Mexican species range southwards into Central and South America than north into the United States, the most natural and convenient line of separation seems to be along the northern boundary of Mexico.

The writer is indebted to Professor Nathan Banks for the opportunity to study the excellent collection of Conopidae in the Museum of Com-

parative Zoology. There were found holotypes or paratypes of Loew, Banks, Robertson, and Camras, many cotypes and autotypes of Williston, and the type species of all the North American genera represented by series. For a similar privilege the writer is obligated to C. H. Curran (American Museum Natural History), E. A. Chapin (U. S. N. M. unfortunately only in part), M. T. James (Colorado State College Agr. and Mech. Arts), R. L. Post (Oregon State College), H. E. Jaques (Iowa Wesleyan College), and R. P. Dow (New England Mus. Nat. Hist.). For information on types the writer is indebted to Professor R. H. Beamer (Snow Entomological Collections) and Dr. H. Oldroyd (British Museum).

KEY TO SUBFAMILIES AND GENERA

1. Cubital (anal)[1] cell very small; ovipositor very long; pteropleura with a long bristle; vertex, lateral margins of dorsum of thorax, and scutellum with a few long, strong bristles; proboscis long and geniculate; third antennal segment with a subdorsal arista; tibiae spurred (Stylogastrinae), **Stylogaster** Macq.
   Cubital (anal) cell rather long and pointed; ovipositor not excessively long; pteropleura unarmed; vertex, lateral margins of dorsum of thorax, and scutellum without bristles, or with a few which are but little differentiated from the surrounding hairs; tibiae unarmed at apices.................... 2
2. Third antennal segment with a three-segmented style at apex; abdomen constricted basally, the second and usually the third segments longer than broad; subcosta (Sc_1) and first branch of radius (R_{1+2}) connected by an apparent cross vein (Sc_2); halteres with some short hairs at base of knobs on outer side; ocellus usually vestigial or absent (present in *Physosonops*); proboscis directed forward, not geniculate (Conopinae)................... 3
   Third antennal segment with a dorsal two-segmented arista; abdomen not noticeably constricted basally, the second and third segments each broader than long; ocelli present; proboscis usually geniculate (directed forward in *Zodion* and *Robertsonomyia*).. 5
3. Radio-medial (anterior) crossvein situated at most a little beyond the middle of the 1st M_2 (discal) cell; hind femora regularly thickened, the thickest part at middle; ocellus present, vestigial, or rarely absent; propleura with at least one bristle on lower margin............................. 4
   Radio-medial (anterior) crossvein situated well beyond the middle of cell 1st M_2 (discal); hind femora irregularly thickened on basal half; ocellus absent; propleura bare...........................**Physocephala** Schiner
4. Ocellus on vertex distinct and protuberant, very rarely reduced (within a single species); first and second abdominal segments slender to very slender; third abdominal segment strongly constricted anteriorly to a width equal to that of second; second and third abdominal segments each distinctly longer than fourth; propleura almost always with one bristle at base, **Physoconops** Szilady
   Ocellus on vertex vestigial or absent, very rarely distinct; first and second abdominal segments only feebly constricted; second and third abdominal segments each about as long as the fourth; propleura usually with more than one bristle at base.................................**Conops** Linn.

[1]The terms for wing nomenclature are those generally used in other insect orders and must be used in Diptera if we are ever to have a uniform system. The system followed here is that of Comstock-Needham (1918) with the modifications of Tillyard (1919) and Alexander (1927, 1929). Until they have been tested further, the radical emenations proposed by Lameere (1922), Vignon and Séguy (1929, 1932), and Goffe (1947) are not followed. The terms in parentheses are those heretofore utilized in the Conopidae. Consult the accompanying figure of the Conopid wing.

5. Cubital (anal) cell much longer than M (second basal) cell; female with the seventh abdominal segment large and shoe-shaped, the eighth much reduced; male with six unmodified abdominal segments (Myopinae)...... 6
   Cubital (anal) cell but little longer than M (second basal) cell; female with seventh and eighth abdominal segments strongly narrowed and produced anteriorly to about the middle of abdomen; male with five unmodified abdominal segments (Dalmanniinae)................**Dalmannia** Rob.-Desv.
6. Proboscis produced anteriorly, not geniculate at middle, usually an apparent crossvein (Sc_2) connecting subcosta (Sc) and first branch of radius (R_{1+2}).. 7
   Proboscis geniculate at or near middle as well as at base; usually no apparent crossvein (Sc_2) connecting subcosta (Sc) and first branch of radius (R_{1+2}), these veins sometimes slightly fused at apices........................ 8
7. Femora without short thorns on apical half of antero-and postero-ventral surfaces; radial-five (first posterior) cell usually open, or closed at extreme apex; palpi very small, not longer than diameter of proboscis at their bases..**Zodion** Latr
   Femora with some short thorns on apical half of antero- and postero-ventral surfaces; radial-five (first posterior) cell long-stalked (rarely closed at apex, very rarely slightly open); palpi long, about three times as long as diameter or proboscis at their bases......................**Robertsonomyia** Malloch
8. Cheeks narrower than height of eye...................................... 9
   Cheeks at least as wide as eye height..........................**Myopa** Fabr.
9. Antennae longer than the front; propleura haired; abdomen short, especially in the female; hind coxae with some hairs on inner posterior margin, **Occemyia** Rob.-Desv.
   Antennae shorter than the front; propleura bare; abdomen of female long and narrow; inner posterior margin of hind coxae bare (Palaearctic), **Sicus** Scop.

Genus **Conops** Linnaeus

Linnaeus, 1758, Syst. Nat. 10th ed., p. 604.

Genotype: *Conops flavipes* Linn., the fifth species, by designation of Curtis, 1831, Brit. Ent., p. 377. Subsequently Kröber chose as the genotype *Conops macrocephala* Linn., 1761, Fauna Suecia, p. 467.

Synonyms: *Conopejus* Rondani, 1845; *Conopoideus* Rondani, 1845; *Pleurocerina* Macquart, 1851; *Conopilla* Rondani, 1856; *Sphyxosoma* Rondani, 1856; *Bombibia* Lioy, 1864.

All the Nearctic and West Indian species heretofore placed under *Conops* belong in *Physoconops*. Although Krober, 1939, lists some Neotropical species under *Conops*, the only New World *Conops* the writer has seen is *C. bermudensis* Parsons (Psyche, 1940, 47: 28) of Bermuda.

Genus **Physoconops** Szilady

Szilady, 1926, Ann. Mus. Nat. Hungar., 24: 588.

Genotype: *Conops brachyrhynchus* Macquart.

The following species are here excluded from our lists. *Conops? quadrimaculatus* Ashmead, 1880, Orange Insects, p. 69, is listed under *Conops* by Aldrich (Suppl., 1907) and Van Duzee (1927) but is *Baccha clavata* Fabr. (Syrphidae). When Mr. Nathan Banks was shown Ashmead's description, he made the abode determination, which was confirmed on examination of specimens. C. W. Sabrosky has stated (in litt.) that there is no type of *quadrimaculatus* in the U. S. N. M. and that Dr. Aldrich places it as a synonym of *Vaccha clavata* in the card catalogue from the description alone. Macquart (1843) recorded

Conops costatus Fabr., *pictus* Fabr. and *analis* Fab. from "Caroline" and these species have been included in our lists ever since. The first was described from South America and apparently is still indeterminate. The second has been placed in *Physoconops* and restricted by the present writer (1940) to the Greater Antilles, from which it was described. The third has been placed in *Physocephala* by Kröber (1939) who gives the range as Mexico to Brazil. On the basis of specimens from southern Florida it is here included under *Physocephala* where it is discussed. Also Macquart (1843) described *Conops flaviceps* from "Amerique Septentrionale." It is a very small species and because of a brown spot at the apex of the wing may be one of the Neotropical *Physoconops* or *Physocephala*. An attempt has been made to place the species according to their affinities and they should so be arranged in the collection.

For keys and descriptions consult Williston (Trans. Conn. Acad. Arts & Sci. 1882, 4: 325–342; 1885, 6: 377–379).

Physoconops obscuripennis (Williston)

Conops obscuripennis Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 328–9.
Conops brachyrhynchus Macq., of Williston and others in error.
Conops foxi Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 574.

Types: of *obscuripennis* a single type from South Carolina in Snow Entomological Collections at Lawrence, Kans. (Williston also mentions Virginia, Georgia, and Massachusetts and so some Osten Sacken specimens in M. C. Z. may be cotypes); of *foxi* from Pullman, paratype from Metaline Falls, Washington, in Calif. Acad. Sci. Curran (Can. Ent. 59: 32) has pointed out that Williston was in error in calling this species *brachyrhynchus* and that Williston's *xanthopareus* is *brachyrhynchus* of Macquart. Since Van Duzee quotes Kröber in his key, he evidently did not have specimens which would have shown that his *foxi* must be identical. The M. C. Z. has specimens ranging from Mass. to Florida, west to Louisiana, Colorado, Nebraska, and Washington (Little Spokane). Others have been seen from Iowa, and it is recorded from B. C. by Kröber, from S. Dak. by Aldrich and N. M. by Townsend.

Physoconops sylvosus (Williston)

Conops sylvosus Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 329–330.
Conops arizonicus Banks, 1916, An. Ent. Soc. Amer. 9: 191-2.

Types: of *sylvosus* a single type from Massachusetts in the Snow Entomological Collections at Lawrence, Kans. (Williston also mentions Connecticut); of *arizonicus* holotype No. 13547 from Palmerlee, Arizona, in the M. C. Z.

Banks based *arizonicus* on a small female which differs from typical *sylvosus* in a smaller ventral plate, dark cloud on wing extending to cubitus, first branch (fifth vein), no pale bands on abdomen, and by the longer third antennal segment. Some of these differences do not hold in other specimens in the M. C. Z. from Arizona and Texas, which have been added since Banks wrote his description. Others of these differences disappear on examination of a series of eastern specimens. Also Williston has recorded *sylvosus* from Mexico (Guerrero) and

Giglis-Tos notes its occurrence in Tehuacan. The four Texan and Arizona specimens seen are all small but no smaller than some eastern specimens. It is evidently a very variable species. The M. C. Z. material ranges from Mass. to Virginia, Texas (Fort Davis) and Arizona (Palmerlee, Fort Grant, Dragon). The A. M. N. H. and New England Mus. N. H. have specimens from Franconia, N. H.

Physoconops semifuscus (Banks)

Conops brachyrhynchus var. *semifuscus* Banks, 1916, Ann. Ent. Soc. Amer., 9: 192.

Type: holotype No. 13546 collected July 6, Jemez Springs, New Mexico, in the M. C. Z.

As Mr. Banks indicated, this species is related to *obscuripennis*, but it has a longer ventral plate, a slightly longer third antennal segment, paler femora, humeri yellow pollinose, and differently colored wings.

Physoconops bulbirostris (Loew)

Conops bulbirostris Loew, 1853, Neue Beitrage Kennt. Dipt., p. 30.

Type: from an unknown locality presumably in the Berlin Museum, referred to North America by Osten Sacken.

The M. C. Z. series range from New Jersey to Florida. Kröber records it from Texas, Mexico, Bolivia, Brazil, and Paraguay.

Physoconops nigrimanus Bigot

Conops nigrimanus Bigot, 1887, Ann. Soc. Ent. France, p. 38.
Conops limuva Brimley, 1927, Ent. News, 38: 235.

Types: of *nigrimanus* from Georgia in the collection of J. E. Collins, England; of *limuva* (not seen) from Raleigh, N. C., in the collection of the N. C. Dept. of Agriculture.

Descriptions of the two species agree closely and especially with respect to a yellow spot (sometimes obscure) behind the vertex, a characteristic not found in any other of our species. The M. C. Z. has a small series from New Jersey, that were mixed in with *bulbirostris*. Known also from North Carolina and Georgia.

Physoconops fronto (Williston)

Conops fronto Will., 1885, Trans. Conn. Acad. Arts & Sci. 6: 378–9.
Conops striatifrons Kröber, 1915, Arch F. Naturg, Abt. A. H. 5, p. 132.
Conops pulchellus Kröber, 1915, Arch F. Naturg. Abt. A. H. 5, p. 134.
Conops argentifacies Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 574–5.
Conops fraterculus Van Duzee, 1927, loc. cit., p. 575–6.
Conops rubicundulus Van Duzee, 1927, loc. cit., p. 576–7.

Types: of *fronto* three cotypes from western Kansas in the Snow Entomological Collections at Lawrence, Kans., autotype from Umatilla, Or., in M. C. Z.; of *striatifrons* from Georgia and Texas in the Berlin Museum, allotype from Lincoln, Nebraska, in the Kröber collection, Hamburg; of *pulchellus* from South Carolina in the Vienna Museum; of *argentifacies*, *fraterculus*, and *rubicundulus* all from Lewiston, Idaho, and in the Calif. Acad. Sci.

Since Kröber merely quoted Williston's description, he evidently did not understand this species and so described specimens from the West and East as two new species. Since Van Duzee keyed *fronto* from the description and gives only Kansas as the distribution, he also did not know *fronto*. His description of *argentifacies* agrees exactly with a specimen from Oregon in the M. C. Z. identified as *fronto* by Williston. The differences Van Duzee ascribes to *fraterculus* and *rubicundulus* fall well within the range of variation of *fronto*. Bohart and MacSwain (1940, Pan-Pacific Ent. 16: 91) record *argentifacies* as a parasite of *Megachile perihirta* Cockerell.

The M. C. Z. has specimens from Oregon, Colorado, Nebraska, New Mexico, Texas, and one from Cambridge, Mass. Additional localities represented in the A. M. N. H. are Lusk, Wyo., Antioch, Calif., and one from Valdosta, Georgia, is aberrant in having the posterior portion of the abdomen uniformly dark and nearly as dark as the anterior portion.

Physoconops brachyrhynchus (Macquart)

Conops brachyrhynchus Macquart, 1843, Dipt. exot. 2: 15.
Conops xanthopareus Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 332–3.
Conops fenestratus Krober, 1915, Arch. F. Naturg. Abt. A. H. 5, p. 134–5.

Types: of *brachyrhynchus* from "Amerique septentrionale" probably in the Mus. Hist. Nat., Lille; of *xanthopareus* a specimen labelled "Type Wlstn 441" in the M. C. Z. and a cotype from Connecticut in the Snow Entomological Collections at Lawrence, Kans. (since Williston also mentions Texas and Massachusetts, some of Osten Sacken's specimens in M. C. Z. may be cotypes); of *fenestratus* from Lincoln, Nebraska, paratypes from Texas, Delaware, and Louisiana in the Berlin Museum.

Williston did not attempt to apply Macquart's name to any of the material before him and so described his material as new. But Macquart's description and figures leave no doubt of the above synonymy. Kröber's description fits this species, and there even are specimens of *brachyrhunchus* in the M. C. Z. with data identical with that of some of Kröber's paratypes. Also the Mexican *soror* Kröber is very likely this species.

The M. C. Z. has material ranging from Mass. to Florida, west to Texas, Kansas, Nebraska, and Colorado. Others have been seen from Iowa and Kröber records it from southern Arizona.

Physoconops gracilis (Williston)

Conops gracilis Will., 1885, Trans. Conn. Acad. Arts & Sci. 6: 377.

Type: holotype from Arizona in the Snow Entomological Collections at Lawrence, Kans.

Kröber (1939) placed *gracilis* in *Conops*, possibly because the ocellus tends to be reduced in this species, but more probably because his 1939 identification was incorrect as in 1915.

The M. C. Z. material is from Florida, Colorado, New Mexico, Arizona, and Lower California. Kröber records it from Chile and Brazil, but since his 1915 description of *gracilis* applies to *auratus*, these localities may belong to *auratus*.

Physoconops auratus (Townsend)

Conops auratus Towns., 1901, Trans. Am. Ent. Soc. 27: 161–3.

Type: La Cueva, 5300 ft., Organ Mts., New Mexico, cannot be found in the British Museum, U. S. N. M., or Snow Entomological Collections.

The M. C. Z. has a pair from Bill William's Fork, Arizona, and the A. M. N. H. has it from the same locality and also Douglas, Arizona. All the dates of capture are later than usual in the genus, being in August and September. Kröber (1915) records *auratus* from Kansas, Texas, and Mexico, and his description fits *auratus*. But his more complete description of *gracilis* also fits *auratus*; so perhaps the record of Arica, Chile belongs to the latter. Kröber (1927) records *auratus* from Texas and Missouri, but since he states that the ventral plate is small and broad, he has some other species before him.

Physoconops excisus (Wiedemann)

Conops excisus Wied., 1830, Auss. Zweifl. Ins. 2: 234.
Conops sugens Wied., 1830, Auss. Zweifl. Ins. 2: 236.

Types: of *excisus* from Savannah, Georgia, in the Zool. Mus. at Copenhagen (Westermann coll.); of *sugens* from unknown locality in the Vienna Museum.

Loew, having seen both types and compared Mexican specimens with *sugens*, made the above synonymy. The M. C. Z. has two from Florida determined by Loew and others ranging from New York (Long Island) and New Jersey to Florida west to Ohio and Mississippi.

Genus **Physocephala** Schiner

1861, Wiener, Entom. Monatsschr. 5: 137–138.

Genotype: *Conops rufipes* Fabr., monobasic.

Kröber (1939) gives the genotype as *Conops nigra* Deg., 1776, Ins. 6: 105, t. 15, f. 9.

Bohart (1941) Pan-Pacific Ent. 17: 141–4) in a review of the *Physocephala* of the western United States treats two species, *affinis* and *burgessi*. In this paper *affinis* is made a synonym of *texana* and two more species are added to the western fauna, also one to the United States, and several names are synonymized.

For keys and descriptions consult Williston (Trans. Acad. Arts & Sci. 1882, 4: 327–328, 333–342.

Physocephala burgessi (Williston)

Conops burgessi Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 337–8.
Conops brevirostris Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 579–580.
Physocephala brevicornis Bohart, 1941, Pan-Pacific Ent. 17: 144, lapsus.

Types: of *burgessi* one from Mendocino "Calif. Baron Type Wlstn 441" in the M. C. Z., three cotypes same data in Snow Entomological Collections at Lawrence, Kansas (Williston also mentions Colorado); of *brevirostris* from Plumas Co., Calif., in the Calif. Acad. Sci.

The synonymy follows Bohart (1941). This species is represented in the M. C. Z. from Wash., Oregon, Calif., Colo., and Wyoming. It is also recorded from New Mexico by Skinner, from Utah, Idaho, and Montana on flowers of *Prunus* and *Ceanothus* by Bohart.

Physocephala texana (Williston)

Conops texanus Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 338.
Conops affinis Will., 1882, Trans. Conn. Acad. Arts & Sci. 4: 339–340.
Conops ochreiceps Bigot, 1887, Ann. Soc. Ent. France, 7: 39–40.
Physocephala humeralis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 580-581.
Physocephala humeralis simulans Van Duzee, loc. cit., p. 581.
Physocephala aurifacies Van Duzee, loc. cit., p. 581–582.
Physocephala buccalis Van Duzee, loc. cit., p. 582–583.
Physocephala rubida Van Duzee, 1934, Ann. Ent. Soc. Amer. 27: 315–316.

Types: of *texana* from Waco, Texas, 3 cotypes in U. S. N. M. (No. 882); of *affinis* a single type from Washington Territory in the Snow Entomological Collections at Lawrence, Kans., (Williston also mentions Kansas and California so specimen from "Cal." in M. C. Z. may be cotype); of *ochreiceps* from Georgia and Mexico in the collection of J. E. Collin, England; of *humeralis* from Idaho, of *simulans* holotype from Calif., paratypes from Utah, Idaho, Wash., of *aurifacies* from California, of *buccalis* holotype from Utah, paratypes from Calif., and Wash. in Calif. Acad. Sci.; of *rubida* from Oregon in the collection of W. W. Barker, Puyallup, Wash.

Some of the Neotropical names very likely will be found to belong to this very variable species. Since Bohart reared over 100 specimens from a single nest of Bembecid wasps and found variations enough to include all five of Van Duzee's species, the other names are invalid also. The M. C. Z. has it from Indiana, N. Mex., Ariz., Calif., Colo., Utah, Oregon, and Wash. It is also recorded from Georgia by Bigot, from Kansas and Texas by Williston, from Idaho by Van Duzee, from Mexico by Bigot and Giglio-Tos, and from Montreal, Quebec by Chagnon. Townsend's Michigan record is evidently of *marginata*. Under the name *affinis* Bohart and MacSwain (1939, Bull. So. Calif. Acad. Sci. 38: 84 and 1940, Pan-Pacific Ent. 16: 16) have recorded this species as a parasite of *Bembix comata* Parker and *Bembix occidentalis beutenmuelleri* Fox.

Physocephala marginata (Say)

Conops marginata Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 82–83.
Conops sagittaria Say, 1823, loc. cit. 3: 83.
Conops aethiops Walker, 1849, List. of Dipt. Ins. in B. M., Pt. 3, p. 671.
Conops genualis Loew, 1853, Neue Beitrage, 1: 32.
Conops castanoptera Loew, 1853, loc. cit. p. 33.
Conops ruficornis Van Duzee, 1934, Ann. Ent. Soc. Amer. 27: 315–6.
Conops dakotennis Van Duzee, 1934, loc. cit. p. 317–8.
Conops stylifer Van Duzee, 1934, loc. cit. p. 318–9.

Types: of *marginata* from Missouri is lost; an almost certain cotype is in the Vienna Museum (Wiedemann coll.); of *sagittaria* from Pennsylvania is lost; of *aethiops* from North America in the B. M.; of *genualis* a male from N. A. in the Vienna Museum and a female No. 439 from Kentucky in the M. C. Z.; of *castanoptera* a male from Savannah,

Georgia, and a female from Carolina, both in the Berlin Museum; of *ruficornis*, *dakotensis*, and *stylifer*, all reared from honey bees at Fargo, North Dakota, and in the collection of W. W. Barker, Puyallup, Washington.

This very variable species may be black or pale rufous. The cell 1st M_2 (discal) may be mostly hyaline (*marginata*), or entirely dark (*sagittaria*), or intermediate; when the cheeks are pale or when the face is brownish, the pale spot on cheek is barely noticeable (*genualis*). Southern specimens are much more rufescent (*castanoptera*). Since Van Duzee states that the first and second antennal segments are of nearly equal length, he evidently did not know *marginata*. The differences to which Van Duzee gives names are too minor to recognize.

The M. C. Z. has specimens ranging from Massachusetts to Florida west to Texas, and one from Corvallis, Oregon. The A. M. N. H. has it also from St. Anne's, Quebec; Ottawa, Kansas; Lander, Wyo.; and Nicola Valley, B. C. Also it is recorded from "Missouri" by Say, from the White Mts., N. H., by Williston, and from Michigan by Townsend, under *affinis*.

Physocephala furcillata (Williston)

Conops furcillata Will, 1882, Trans. Conn. Acad. Arts & Sci. 4: 336-7.
Physocephala sorocula Will., 1892, Biol. Centr.-Amer. Diptera, 3: 83.
Physocephala lucida Van Duzee, 1931, Can. Ent. 63: 284.

Types: of *furcillata* one from "Jefferson, N. H., Aug. 1, 1877, Type Wlstn 441" in the M. C. Z. and 3 cotypes from "White Mts." in the Snow Entomological Collections at Lawrence, Kans.; of *sorocula* from Guerrero, Mexico, in the B. M.; of *lucida* from Gull Lake, Ontario, in the Calif. Acad. Sci.

Evidently the hiatus between New Hampshire and Guerrero led Williston to describe *sorocula*, the name with which Van Duzee compared his *lucida*. A remarkably constant species, the one rufous specimen seen is from Pt. Pelee, Ontario. The M. C. Z. has *furcillata* ranging from Nova Scotia, Quebec, Ontario, and Michigan south to New Jersey, also Colton, San Bernadino Co., California, and Juan Mina, Rio Chagres, Panama Canal Zone. Also it is in the A. M. N. H. from Price Co., Wisconsin, and Williston recorded it under *sorocula* from Guerrero, Mexico.

Physocephala tibialis (Say)

Conops tibialis Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 83.
Conops nigricornis Wied., 1830, Auss. Zweifl. Ins. 2: 236.
Conops fulvipennis Macq., 1843, Dipt. Exot. 2: 13-14.
Conops lugubris Macq., 1843, loc. cit. p. 16.

Types: of *tibialis* from Indiana is lost; of *nigricornis* from Pennsylvania in the Vienna Museum; of *fulvipennis* from Georgia presumably in the Mus. Hist. Nat. at Lille; of *lugubris* from an unknown locality, a male (not female as Macquart says) is in the B. M.

Macquart's descriptions and figures agree so closely with this species, that it seems safe to place his names in synonymy, especially since arriving at this decision the writer has noticed that Kröber (1939,

Ann. Mag. Nat. Hist. 4: 540–1) states that the male type of *lugubris* is in London and is a synonym of *tibialis*. Rarely the extremities of the radial-three (submarginal), radial-five (first posterior), and 1st M_2 (discal) cells tend to become hyaline, and pollen near the humeri is usually very obsolete. The M. C. Z. has *tibialis* ranging from Massachusetts to Florida, west to Dallas, Texas and Baldwin, Kansas.

Physocephala analis (Fabricius)

Conops analis Fabr., 1775, Syst. Ent. p. 175.
Conops nigrifacies Bigot, 1887, Ann. Soc. Ent. France, 7: 40–41.
Conops carbonarius Bigot, 1887, loc. cit. p. 42.

Types: of *analis* from South America possibly at Kiel; of *nigrifacies* and *carbonarius* from Mexico in the B. M.

Kröber (1939, p. 460) places *carbonaria* as a synonym of *analis* and *nigrifacies* ("nigrofacies") as a doubtful synonym. Unfortunately some of Kröber's characters contradict the descriptions. Williston (1892) redescribes both of Bigot's species but is not sure of his identifications. H. Oldroyd writes that the type of *nigrifacies* is placed in the B. M. as a synonym of *analis*, and that the type of *carbonarius* is "similar in appearance, but bigger and blacker." The latter is evidently considered distinct. The M. C. Z. has a male from Florida (Pinecrest, July 19, G. Fairchild) which differs from the description of *nigrifacies* in being much larger, lacking the golden pollen on front, face, and cheeks, and the 1st M_2 (discal) cell entirely dark. It agrees with *carbonaria* in size, but differs in the dark facial grooves, and the dark 1st M_2 (discal) cell. A female from Mexico (M. C. Z.) differs principally in having a yellow face, coxae and tarsi pale, thorax and halteres black, and apical half of 1st M_2 (discal) cell hyaline. In the U. S. N. M. are two females from Florida (one from Haulover, March 9, and the other from Crescent City). These agree with the Pinecrest specimen except that the basal enlargement of proboscis is pale, face yellow with central black on each side, femora reddish brown. It is hard to believe that the sexes described under *carbonaria* by Bigot, Williston and Kröber really belong to the same species.

The Pinecrest male is here diagnosed. Length without antennae 17 mm.; head black, except vertex, margins of face, lower part of facial grooves, and antennae which are reddish brown; antennal segments (minus style) as 3 : 10 : 5; style with second segment nearly twice as long as first two combined; proboscis black, twice as long as head; thorax reddish brown with three black stripes above, covered with very fine grey pollen, no lateral stripe of pollen, halteres yellow; legs reddish brown, coxae, basal halves of hind femora, and apical two-thirds of tarsi black; abdomen black, first two segments brownish, apex covered with very fine grey pollen; wings with dark brown stripe extending to vein Cu_1 (fifth) and narrowly along 1st A vein (sixth).

Genus **Dalmannia** Robineau-Desvoidy

Rob.-Desv., 1830, Essai sur les Myodaires in Mem. Divers. Savans Acad. Roy. Sci. Inst. France (Sci. Math. Phys. 2: 248).

Genotype: *Myopa punctata* Fabr., the third species, by designation of Rondani, 1856, Dipt. Ital. Prodr. 1: 59.

Synonyms: *Stachynia* Macquart, 1833; *Arpagita* Lioy, 1864.

G. E. Bohart (1938) has published a key to the North American species (Pan-Pacific Ent. 14: 132–136). His habitat data is not repeated, but supplementary data is added.

Dalmannia vitiosa Coquillett

Dalmannia vitiosa Coq., 1892, Ent. News, 3: 150–151.

Type: from Los Angeles Co., California, in the U. S. N. M.

Bohart records material from Sonoma and Orange Counties, Calif., and Kansas. The M. C. Z. has it ranging from New Hampshire to Virginia, also Pinaleno Mts., Arizona. The A. M. N. H. has this species from Fallon, Nevada, and also a male from Globe, Arizona, which is aberrant in having the cross-vein nearly normal, a yellow spot on each humerus, and the antennae black with the third segment shorter than usual.

Dalmannia picta Williston

Dalmannia picta Will., 1883, Trans. Conn. Acad. Arts & Sci. 6: 94.

Type: a single type from New Mexico in the Snow Entomological Collection at Lawrence, Kans.

Bohart records this species from the Chiricahua Mts., Ariz., and Mohave, Calif. The M. C. Z. has *picta* from Colorado and California (Claremont, Redlands).

Dalmannia blaisdelli Cresson

Dalmannia blaisdelli Cresson, 1919, Proc. Acad. Nat. Sci., Philad. 71: 190.

Type: from Colorado in the Philad. Acad. Nat. Sci.; paratype from Mokelumne Hill, Calaveras Co., Calif. in Calif. Acad. Sci.

Bohart gives the California record as the type locality but Mr. E. T. Cresson, Jr., kindly re-examined the type and states that it is from Colorado. Bohart adds several California records. The M. C. Z. has it from California and Ft. Collins, Colorado, and the A. M. N. H., from Boulder and Walden, Colorado.

Dalmannia nigriceps Loew

Dalmannia nigriceps Loew, 1866, Berlin Ent. Zeitsch., 10: 40; Centuriae VII, p. 100–101.

Type: holotype No. 449 from Virginia in the M. C. Z.

Bohart saw specimens from Holliston, Mass. The M. C. Z. has this species ranging from Vermont to Virginia west to Lincoln, Nebraska. The New England Mus. N. H. and A. M. N. H. have it from Franconia, N. H., and the latter also from Aylmer; Quebec.

Dalmannia pacifica Banks

Dalmannia pacifica Banks, 1916, Ann. Ent. Soc. Amer. 9: 199–200.
Dalmannia hirsuta Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 591.

Types: cotype No. 13545 of *pacifica* from Corvallis, Oregon, in the M. C. Z. and cotype in collection of Oregon Agric. College; of *hirsuta* from Corvallis, Oregon, in the Calif. Acad. Sci.

Bohart, who examined the type of *hirsuta*, states that it is the female of *pacifica*. He records specimens from Berkeley and Davis, California. The M. C. Z. has another example from Springfield, Oregon. The A. M. N. H. has a series from Davis, Calif., taken on the unusually late date of July 2. Two of these have the yellow markings reduced.

Dalmannia heterotricha G. Bohart

Dalmannia heterotricha G. Bohart, 1938, Pan-Pacific Ent., 14: 134–135.

Type: from Pt. Reyes Peninsula, Marin Co., Calif., in Calif. Acad. Sci. This species, found on the sand dunes, has not been seen by the writer.

Genus **Myopa** Fabricius

Fabricius, 1775, Syst. Ent., p. 798.

Genotype: *Conops buccata* Linn., the sixth species, by designation of Curtis, 1838, Brit. Ent., vol. 8, p. 677, pl. 677. Kröber (1939) subsequently designated as the genotype *Conops testacea* Linn., 1759, Syst. Nat., ed 11, 2: 1006.

Synonyms: *Fairmairia*, *Haustellia*, *Lonchopalpus*, *Myopella*, *Myopina*, *Phorosia*, *Pictinia*, *Purpurella* all by Rob. Desv., 1853; *Gonirhynchus* Rond., 1857.

A character of generic importance, omitted by American and denied by European writers, is that the fifth ventral segment of the female is produced, as in the other genera (except *Sicus*). It is true that in the few European species examined (including the genotype) and over half of the North American species the fifth segment is not produced at all or very slightly. This condition is true in *melanderi*, *vicaria*, *fenestratus*, *willistoni*, *seminuda*, *rubida*, *clausa*, and *aperta*. But in the following species the ventral plate is greatly produced so that it attains or overlaps the apex of the eighth segment: *vesiculosa*, *varians*, *longipilis*, *flavopilosa*, *plebeia*, and *virginica*. Since the produced ventral plate is the most distinctive character of *Melanosoma* Rob.-Desv., 1853 (*Gossigona* Rondani, 1856), this writer attempted to place the North American species with this character in *Melanosoma*. But an examination of a series of the genotype (*bicolor* Meig.) in the M. C. Z. shows *Melanosoma* to differ in other ways, particularly in a distinctly longer proboscis and tubular abdomen as described by Schiner (1862, pp. LXVII, 383). Possibly one of the above listed synonyms is available.

Descriptions of most of the species will be found in two papers, one by Williston (Trans. Conn. Acad. Arts & Sci. 1885, 6: 382–387) and one by Banks (Ann. Ent. Soc. Amer. 9: 196–198).

Myopa melanderi Banks

Myopa melanderi Banks, 1916, Ann. Ent. Soc. Amer. 9: 197.

Type: holotype No. 13551 and paratype from Pullman, Washington, in the M. C. Z.

Of this species all that has been seen is the type, allotype, and one other specimen all collected in May and June at Pullman, Washington.

Myopa vicaria Walker

Myopa vicaria Walker, 1849, List. of Dipt. Ins. in B. M. 3: 679.
Myopa pilosa Will., 1885, Trans. Conn. Acad. Arts & Sci. 6: 383–4.

Types: of *vicaria* from Nova Scotia in the British Museum; of *pilosa* a single type from Kern Co., California, in the Snow Entomological Collection at Lawrence, Kans.

The M. C. Z. has this species ranging from Nova Scotia to Virginia west to Illinois and Michigan, also one from Pullman, Washington. Others have been examined from Oregon (Or. State College) and the following in the A. M. N. H.: Ontario, Quebec, Wyoming, and Arizona. Specimens from England and Sardinia (A. M. N. H.) are identical.

Myopa fenestrata Coquillett

Myopa fenestrata Coq., 1902, Can. Ent. 34: 197–8.

Type: from 7300 ft., Sierra Madre, Chihuahua, Mexico, in the U. S. N. M.

Kröber (1939) omitted this species, which is likely to turn up in our southwestern states. The M. C. Z. has a female from Amecameca, Mexico.

Myopa willistoni Banks

Myopa pictipennis Will., 1885, Trans. Conn. Acad. Arts & Sci. 6: 382–3 (nec *pictipennis* Rob.-Desv., 1830).
Myopa willistoni Banks, 1916, Ann. Ent. Soc. Amer. 9: 197.

Type: one specimen labelled "Type Wlstn Cal 447" in the M. C. Z., 3 cotypes from California and one from Arizona in the Snow Entomological Collections at Lawrence, Kans.

The M. C. Z. has *willistoni* from California and Mary's River, Oregon, and the A. M. N. H. has it taken in March at Globe, Arizona. Giglio-Tos records it from Toluca, Mexico.

Myopa vesiculosa Say

Myopa vesiculosa Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 80.
Myopa apicalis Walker, 1849, List of Dipt. Ins. in B. M. 3: 679.
Myopa bistria Walker, 1849, loc. cit. p. 679–680.
Myopa conjuncta Thomson, 1868, Eugenies Resa, Diptera, p. 515–6.
Glossigona maculifrons Bigot, 1887, Ann. Soc. Ent. France, 7: 206–7.

Types: of *vesiculosa* from Pennsylvania is lost; of *apicalis* and *bistria* from North America in the British Museum; of *conjuncta* from California in the National Museum, Stockholm; of *maculifrons* from Nevada in the collection of J. E. Collin, England. Walker's *bistria* is placed here with considerable doubt.

The M. C. Z. has this ranging from New Hampshire to Virginia, west through Texas and Nebraska to Washington. The A. M. N. H. has it also from Quebec and Kansas.

Myopa varians Banks

Myopa vesiculosa var. *varians* Banks, 1916, Ann. Ent. Soc. Amer. 9: 196.

Type: holotype No. 13548 from Lincoln, Nebraska (April) in the M. C. Z.

Since *varians* seems to be constant, it may be raised to specific rank. A series from Colorado was received from M. T. James, but no *vesiculosa* were included. An exception is a specimen collected May 30, at Chicago, Illinois (A. M. N. H.) which approaches *varians*, whereas another specimen with the same data is typical *vesiculosa*. In *varians* the abdomen tends to be pale red; the dark cloud in center of wing is usually less distinct than in *vesiculosa*; also the length of body and antennae averages shorter than in *vesiculosa*.

Myopa longipilis Banks

Myopa longipilis Banks, 1916, Ann. Ent. Soc. Amer. 9: 197.

Type: holotype No. 13550 from Pullman, Washington, in the M. C. Z.

In addition to the type the M. C. Z. has one from California which is doubtfully this species, and one from Oregon, part of a series from the Oregon State College. It is in the A. M. N. H. from Antioch and Palo Alto, California.

Myopa flavopilosa Kröber

Myopa flavopilosa Kröber, 1916, Arch. Fur Naturgesch. (1915) Abt. A, H. 7, p. 30–31.

Type: from southern Colorado in the Vienna Museum.

The M. C. Z. has this collected the same day as an example of *rubida* at Elsinore, Utah, also one of three taken at Boulder and Rist Canyon, Colorado, M. T. James. Except for the hair it is very close to *vesiculosa*.

Myopa virginica Banks

Myopa virginica Banks, 1916, Ann. Ent. Soc. Amer. 9: 198.

Type: holotype No. 13552 from Falls Church, Virginia, June 15, paratypes from North Carolina (Black Mt.), Virginia (Falls Church and Glencarlyn), and New York (Catskill Mts.) in the M. C. Z.

This species is in the M. C. Z. ranging from Connecticut to North Carolina west to Michigan. It is in the New England Mus. N. H. from Vermont. Three specimens from the Catskill Mts., June (A. M. N. H.) are larger and have longer hair than usual.

Myoba plebeia Williston

Myopa plebeia Will., 1885, Trans. Conn. Acad. Arts & Sci. 6: 384–5.
Gonirhynchus castaneus Bigot, 1887, Ann. Soc. Ent. France, 7: 207–8.

Types: of *plebeia* three cotypes from Arizona in the Snow Entomological Collection at Lawrence, Kans.; of *castaneus* from Nevada in the collection of J. E. Collin, England.

The M. C. Z. has *plebiea* from Washington, California, and New York. The specimen from New York has the two basal tergites red and differs somewhat in other ways. It is in the A. M. N. H. from Arizona and California.

Myopa seminuda Banks

Myopa seminuda Banks, 1916, Ann. Ent. Soc. Amer. 9: 198.
?*Glossigona rubida* Bigot, 1887, Ann. Soc. Ent. France, 7: 206.

Types: of *seminuda* holotype No. 13549 from base of Mary's Peak, Oregon, (May 14) in M. C. Z. paratypes from same locality and Cor-

vallis, Or., in M. C. Z. and Oregon State College; of *rubida* from Colorado in the collection of J. E. Collin, England.

If *rubida* should prove to be conspecific with *seminuda* then, as the older name, it will take priority. The description of *rubida* also applies to *aperta*. See under *curticornis* for a further discussion of *rubida*. The M. C. Z. has *seminuda* from Washington, Oregon, California, Idaho, and Colorado, June–Sept., where it is evidently the commonest *Myopa*. The A. M. N. H. has it also from Wyoming. Specimens with slightly longer hair than usual and cell R_5 (first posterior) narrowly open instead of closed at apex should perhaps be placed under *aperta* Röder. Under the name *rubida* Bigot this species is recorded as a parasite of several species of *Andrena* by Bohart (1941, Pan-Pacific Ent. 17: 95–96).

Myopa curticornis Kröber

Myopa curticornis Kröber, 1916, Arch. fur Naturg. (1915), Abt. A, H. 7, p. 32.

Types: from Colorado and California in Mus. Civ. Stor. Nat. (Bezzi coll.) at Milan.

Banks (1916) applied the name of *Glossigona rubida* Bigot to a western species that resembles *clausa* but has a distinctly shorter proboscis and antennae. Since Bigot placed *rubida* in *Glossigona*, which has a produced ventral plate, the name *rubida* cannot be applied to the present species. Kröber's *curticornis*, which is much more definitely, described, is then available. Van Duzee (1927), evidently misled by the two types of ventral plate in **Myopa**, thinks *curticornis* should perhaps go into *Sicus*. The M. C. Z. has this species from Washington, California, Utah, Colorado, and Maine. Others have been seen from Colorado (Col. State Coll.) and Oregon (Or. State Coll.).

Myopa clausa Loew

Myopa clausa Loew, 1866, Centuriae VII, no. 72, p. 101.

Type: holotype No. 448 from Maine in the M. C. Z.

Williston (1885) included (perhaps correctly) specimens from Arizona, California, Washington Territory, Wyoming, and California under *clausa*, although he based his description chiefly on specimens from Massachusetts and Connecticut. The western specimens are now known as *rubida*, *seminuda*, and *aperta*, and the last two may easily belong with *clausa*. But, as at present restricted, *clausa* is confined to the east. The M. C. Z. has it ranging from Maine to North Carolina, and the A. M. N. H. has it also from Sioux City, Iowa. One of the North Carolina specimens has the radial-five cell (first posterior) very narrowly open. Röder (1889) places *castanea* Bigot as a synonym of *clausa*, but he apparently follows Williston and does not recognize the forms here called *seminuda* and *rubida*.

Myopa aperta Röder

Myopa clausa var. *aperta* Roder, 1889, Wien, Ent. Zeit. 8: 5.

Types: from Nevada and British Columbia in the Zool. Museum at Halle.

The M. C. Z. has *aperta* from Washington, Utah, and Colorado. Others have been seen from Oregon (Or. State Coll.), California and Wyoming (A. M. N. H.).

Genus **Zodion** Latreille

Zodion Latreille, 1796, Précis des Caract. Gén. p. 162, no species mentioned; 1802, Hist. Nat. Crust. et Ins. 3: 444.

Genotype: *Myopa cinerea* Fabricius, monobasic.

Of all our genera *Zodion* is the most difficult in the determination of species. Recently Sidney Camras, in three papers (Ent. News, 54: 187–191, 1943; Pan-Pacific Ent., 20: 121–128, 1944; and 21: 31, 1945) has ably brought workable order into the genus and on pp. 127–128 presents a key to species. This writer, just before the war, had similarly revised the genus and had proposed in manuscript many of the changes made by Camras. The only major difference is that this writer places the last four species, recognized by Camras, in *Robertsonomyia* Malloch, a genus not mentioned by Camras but which includes as its genotype the first of these four species. In agreement with Camras (1945), *Zodion bimaculata* Curran is transferred to *Occemyia.*

Zodion pictulum Williston

Zodion pictulum Williston, 1885, Trans. Conn. Acad. Arts & Sci. 6: 379–80.

Type: holotype from New Mexico in the Snow Entomological Collections at Lawrence, Kansas.

Camras, p. 187, merely places *pictulum* in a separate group, p. 187, and in the key, p. 127, without giving data. The only specimen seen is one from 6800 ft., Williams, Arizona, Aug. 8, 1934, in the A. M. N. H.

Zodion cyanescens Camras

Zodion cyanescens Camras, 1943, Ent. News, 54: 188–190.

Types: holotype and allotype from Smokemont, North Carolina, in Chicago Mus. Nat. Hist.; two paratypes No. 26684 from Monticello, Fla., and Raleigh, N. C., in M. C. Z.; paratypes in various collections.

This species, the southeastern representative of *obliquefasciatum*, occurs from New Jersey to Florida and Mississippi.

Zodion obliquefasciatum (Macquart)

Myopa obliquefasciatum Macquart, 1845, Dipt. Exot., Suppl. I, p. 141.
Zodion splendens Jaennicke, 1867, Neue Exot. Dipt. p. 97–98, Pl. 2, fig. 12.
Zodion leucostoma Williston, 1885, Trans. Conn. Acad. Arts & Sci. 6: 380.

Types: of *obliquefasciatum* from Galveston, Texas, in the Mus. Hist. Nat. at Lille; of *splendens* from Mexico possibly in the Berlin Museum; of *leucostoma* one cotype each from western Kansas, Arizona, and Montana in the Snow Entomological Collections at Lawrence, Kansas two autotypes, possibly cotypes, in the M. C. Z.

Since Williston placed Macquart's name as an unrecognized species of *Myopa*, he redescribed the pollinose phase. Camras (Ent. News. 54: 190) recognizes three phases: melanistic, rufous, and pollinose, and gives the distribution of the three phases. The species occurs all over

the west, east to Illinois and Louisiana, south into Mexico. Additional states not mentioned by Camras but represented in the M. C. Z. are Montana, Washington, and Oregon. An example from Jicara, Guatemala (A. M. N. H.) is aberrant and perhaps closer to *albonotatum*. Townsend (1895) records it from Zacatecas, Mexico.

Zodion albonotatum Townsend

Zodion albonotatum Townsend, 1897, Journ. N. Y. Ent. Soc. 5: 175.

Type: from Brownsville, Texas, cannot be found in the British Museum, U. S. N. M., or Snow Entomological Collections.

This writer had placed this name as a synonym of *obliquefasciatum*, but Camras (Ent. News, 54: 191) recognizes it as a distinct species on the basis of a male, melanistic phase, from Tucson, Arizona, and two males, pollinose phase, from 6400 ft., Jim Creek, Boulder, Colorado.

Zodion fulvifrons Say

Zodion fulvifrons Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 83–84.
Zodion abdominale Say, 1823, loc. cit. 3: 84.
Myopa rubrifrons Robineau-Desvoidy, 1830, Essai sur les Myodaires in Mem. Sav. etr. Acad. Sci., Paris, 2: 247.
Zodion flavipenne Bigot, 1887, Ann. Soc. Ent. France (6) 7: 204.
Zodion lativentre Graenicher, 1910, Canad. Ent. 42: 26.
Zodion sayi Banks, 1916, Ann. Ent. Soc. Amer. 9: 194.
Zodion obscurum Banks, 1916, loc. cit. 9: 194–5.
Zodion reclusum Banks, 1916, loc. cit. p. 195.
? *Zodion bilineata* Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 586–7.

Types: of *fulvifrons* from Md. and Penn. is lost; of *abdominale* from Neb. is lost; of *rubrifrons* from Penn. in Paris Museum; of *flavipenne* from Mex. in coll. of J. E. Collin, England; of *lativentre* from Wis. in Milwaukee Public Mus.; of *sayi* holotype No. 13541 from Falls Church, Virginia, and 3 paratypes: 1 same data, 1 Horse Lake, Or., 1 Mt. Jefferson, Or., in the M. C. Z.; of *obscurum* holotype No. 13543 from Bear Valley, San Bernadino Mts., Calif., in the M. C. Z.; of *reclusum* holotype No. 13543 from Redlands, Calif., in the M. C. Z.; paratypes at Oregon State College; of *bilineata* from Oregon in the Calif. Acad. Sci.

The above synonymy is that of Camras (1944) who has taken the bull by the horns and synonymized more names than this writer inclines to do. Camras also discusses the variations responsible for the different names. Specimens have been seen ranging from Nova Scotia and Ontario west to Washington and California and south into Florida and Mexico.

Zodion intermedium Banks

Zodion intermedium Banks, 1916, Ann. Ent. Soc. Amer. 9: 193–4.
Zodion occidentale Banks, 1916, loc. cit. p. 194.
Zodion basalis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 586.

Types: of *intermedium* holotype No. 13540 from Pocono Lake, Penn., in M. C. Z., 2 paratypes: one with same data and one from Clementon, New Jersey, in M. C. Z., paratypes in U. S. N. M.; of *occidentale* holotype No. 13542 from Montaville, Oregon, one paratype from Corvallis, Oregon, in M. C. Z., paratypes same data and from Mary's River, Oregon, in Or. State College; of *basalis* from Moscow Mts., Idaho, in Calif. Acad. Sci.

This writer had considered *occidentale* a distinct species but is following Camras who found intermediates connecting it with *intermedium*. The M. C. Z. has this ranging from Quebec and Ontario to New Jersey and Penn., west to Texas, Calif., Or., and Wash.

Zodion perlongum Coquillett

Zodion perlongum Coq., 1902, Can. Ent. 34: 199.

Types: from Colorado, New Mexico, and Mexico (Sierra Madre) in the U. S. N. M. (No. 6297).

The M. C. Z. has this ranging from Vermont through Nebraska and Colorado to southern California. It has also been seen from Me., N. H., N. J., Wis., N. M., and Ariz.

Zodion abitus Adams

Zodion abitus Adams, 1903, Sci. Bull., Univ. of Kansas, 2: 33–34.
Zodion bicolor Adams, 1903, loc. cit. p. 35.

Types: of *abitus* one cotype from Douglas Co., Kansas, and one from Mass.; of *bicolor* two cotypes from Douglas Co., Kansas, all in the Snow Entomological Collections at Lawrence, Kansas.

Independently this writer and Camras decided that *abitus* is the female and *bicolor* the male of the same species. The present writer had used the name *abdominale* for this species, but Camras has explained under *fulvifrons* (p. 122) why he placed *abdominale* as a synonym of the latter. The M. C. Z. has *abitus* from Ontario to Virginia, west to Ohio and Kansas. Others have been seen from Quebec (A. M. N. H.) and Colorado (Coll. Agr. Coll.). Kröber (1939) records a female from Nova Teutonia, Brazil.

Zodion angusticornis Van Duzee

Zodion angusticornis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 589.

Type: holotype from Los Banos, California in Calif. Acad. Sci.

Based on a unique female, *angusticornis* has not been recognized by Camras or this writer.

Zodion cinereiventre Van Duzee

Zodion cinereiventris Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 585.

Types: holotype and allotype from Huntington Lake in Fresno Co., paratypes from Pleyto in Monterey Co. and San Diego, California; also Preston, Idaho.

Camras (1944, p. 124) admits that certain examples of *cinereiventre* blend into *abitus* and *triste*, and discusses the relationship. This writer would place *cinereiventre* as a synonym of *triste*. The distribution, after Camras, is western states east definitely to Illinois.

Zodion triste Bigot

Zodion triste Bigot, 1887, Ann. Soc. Ent. France, 7: 203–4.

Type: from California in collection of J. E. Collin.

As Camras states, *triste* may be indistinguishable from *cinereiventre*. He places under *triste* only three examples from San Diego, California.

Zodion nigrifrons Kröber

Zodion nigrifrons Kröber, 1915, Arch. fur Naturgesch. (1915) Abt. A. H. 4, p. 97.
Zodion hirtipes Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 587–8.

Types: of *nigrifrons* from California in Mus. Civ. Stor. Nat. at Milan (Bezzi coll.); of *hirtipes* holotype from Melrose, Alameda Co., Calif., and allotype from Klamath Lake, Oregon, in the Calif. Acad. Sci.

Since Van Duzee merely copied Kröber's key and evidently did not read the description, he redescribed *nigrifrons*. A very dark example from San Jose, Calif., is in the M. C. Z. Camras has seen it from Berkeley, and Fish Ranch, Berkeley Hills.

Zodion americanum Wiedemann

Zodion americana Wiedemann, 1830, Auss. Zw. Insecten 2: 242.
Zodion nanellum Loew, 1886, Centuriae VII, No. 75, p. 102.
Zodion pygmaeum Williston, 1885, Trans. Conn. Acad. Arts & Sci. 6: 381.
? *Zodion occidensis* Walker, 1849, List. Dipt. Brit. Mus., 3: 676.

Types: of *americanum* from Montevideo, Uruguay, in the Vienna Mus. (Wiedemann coll.); of *nanellum* holotype No. 438 from Washington, D. C., in the M. C. Z.; of *pygmaeum* one labelled "Type Wilstn. Calif. Baron 437" in M. C. Z., also 3 coypes from Calif. and one from Colo. in Snow Entomological Collections at Lawrence, Kansas; of *occidensis* from Ohio in the British Museum.

Kröber (1915) states that a female (without head) next to the male type of *americanum* in the Wiedemann collection is identical with *nanellum*. Williston (1885) did not have *nanellum* before him when he described western specimens as *pygmaeum*. Types of both in the M. C. Z. are identical and do not show the differences stated by Van Duzee (1927) and by Kröber (1939). The M. C. Z. has *americanum* ranging from Quebec and Maine to Louisiana west to California (Redlands, Pasadena). Specimens from Trinidad (Dabadie), Brazil (Chapada), and Guatemala (Moca Guatalon) have been seen in the A. M. N. H. Kröber (1939) records it from Mexico, Porto Rico, Venezuela, Columbia, Brazil, Uruguay, Paraguay.

Zodion albifacies Van Duzee

Zodion albifacies Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 588.

Type: from Baboquivari Mts., Arizona, in the Calif. Acad. Sci.

Based on a unique female, *albifacies* has not been recognized by Camras or this writer.

Genus **Robertsonomyia** Malloch

Robertsonomyia, 1919, Proc. Ent. Soc. Wash. 21: 205.

Genotype: *Zodion palpalis* Robertson, monobasic.

This genus was not mentioned by Van Duzee (1927), Curran (1937), or Camras (1944) probably because the genotype has been identified in collections as *Zodion scapularis* instead of *palpalis*. *Robertsonomyia*, as defined in the key, is certainly valid and is intermediate between *Zodion* and *Occemyia*. *Occemyia* also has the thorns on the femora and the long labella but has the first posterior cell (R5) open and the proboscis geniculate. The species are discussed by Camras (1944) under *Zodion*.

Robertsonomyia palpalis (Robertson)

Zodion palpalis Robertson, 1901, Can. Ent. 33: 284.
Sicus brevirostris Coquillett, 1902, Can. Ent. 34: 198.
Zodion scapularis Adams, 1903, Sci. Bull., Univ. of Kansas, 2: 34.

Types: of *palpalis* from Carlinville, Illinois, in the collection of the Illinois Natural History Survey at Urbana, 1 paratype in collection of J. R. Malloch, 1 paratype No. 25888 in M. C. Z.; of *brevirostris* 1 holotype and 1 paratype from 7300 ft., Sierra Madre, Chihuahua, Mexico, in the U. S. N. M.; of *scapularis* a single type from Arizona in the Snow Entomological Collections at Lawrence, Kansas.

Suspecting that *brevirostris* was a synonym of *palpalis*, a copy of the key to genera was sent to Washington. Mr. C. T. Greene kindly wrote (in litt. Aug. 4, 1942), "I checked Coquillett's type of *brevirostris*. It runs out in this key to *Robertsonomyia* Malloch. In the left wing of the type the first posterior cell is *just closed* while the right wing has a *long petiole*. The paratype specimen has both wings like the right [wing]." Camras (1945, p. 31) writes that he examined the type of *brevirostris* and that "it does not seem to differ from (*Zodion*) *palpale*." He also states (1944, p. 126) that the first posterior cell (R5) may be narrowly open. Adams' *scapularis* is maintained as a distinct species by Camras although he had not seen specimens and suspects that an individual variation is involved. The shining inner halves of the humeri, as mentioned by Adams, is not a specific character but due to movement of the head. Mr. Greene wrote that it is not represented, as *palpalis* or *scapularis*, in the U. S. N. M. The M. C. Z. has it from Georgia, Illinois, Nebraska, and Colorado. Camras records it from Raleigh, North Carolina.

Robertsonomyia parva (Adams)

Zodion parvis Adams, 1903, Sci. Bull. Univ. of Kansas, 2: 34–35.

Type: two cotypes from Arizona in the Snow Entomological Collections at Lawrence, Kansas.

The limits of *parva* are highly questionable. This writer had included *lovetti* as a synonym but then admitted that the resulting species is highly variable. Such a species is represented in the M. C. Z. by a small series from Virginia and Nebraska. Camras (1944, pp. 126–7) briefly defines *parva* and *lovetti*, placing the latter as a separate species. He had seen only one example of his version of *parva* from Colorado.

Robertsonomyia lovetti (Van Duzee)

Zodion lovetti Van Duzee, 1934, Ann. Ent. Soc. Amer., 27: 323.

Type: from Fort Collins, Colorado, in Calif. Acad. Sci.

Camras (1944, p. 127) defines *lovetti* and records a unique from Tennessee Pass, Colorado.

Genus **Occemyia** Robineau-Desvoidy

1853, Dipt. des Environs de Paris, Myopaires, p. 50.

Genotype: *Myopa atra* Fabricius, the second of two species, by designation of Coquillett, 1910, Proc. U. S. Nat. Mus. 37: 605.

Synonyms: *Thecophora* Rondani, 1845 *nec* Charpentier, 1840 (also not *Thecophora* Rondani, 1857, of authors); *Melanosoma* Rob.-Desv. 1853; *Oncomyia* Loew; 1866 (emend. of *Occemyia*); *Eccemyia* Graen. 1910, Bull. Wiscons. Soc. Vol. 8, pt. 1, p. 44; *Thecomyia* Brues and Melander, 1932, Bull. M. C. Z., 73: 306 (*lapsus calami teste* Melander *in litt.*).

For discussion of the generic name and synonyms see Parsons (1940, Psyche, 47: 35). Camras (1945, Ann. Ent. Soc. Amer. 38: 216–222) has ably brought workable order to the confusion of names. Nevertheless, as Camras indicates, there are still many points in question. Although this writer's manuscript arrangement of this difficult genus varies from that of Camras, the latter is followed entirely. He also gives a key to species, p. 222. The distribution here given is that of Camras.

Occemyia propinqua Adams

Oncomyia propinqua Adams, 1903, Sci. Bull., Univ. of Kansas, 2: 32.
Oncomyia angusticornis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 595.
Oncomyia longipalpis Van Duzee, 1934, Ann. Ent. Soc. Amer. 27: 321.

Types: of *propinqua* from unknown locality presumably in the Snow Entomological Collections at Lawrence, Kansas; of *angusticornis* holotype and allotype from Moscow Mt., Idaho, paratypes from Wash., Ore., Calif., and Ariz., in Calif. Acad. Sci.; of *longipalpis* holotype from Spanway, Washington, paratype Corvallis, Wash., in Calif. Acad. Sci.

Southern Canada and the United States.

Occemyia nigripes Camras

Occemyia nigripes Camras, 1945, Ann. Ent. Soc. Amer. 38: 218–9.

Types: holotype and allotype from Thunder Bay Beach, Ontario, in Chicago Natural History Museum, 11 paratypes from Vt., N. Y., N. C., Ore., and Wash., in the M. C. Z., many paratypes from Quebec, Ontario, Manitoba, all parts of the United States and one from Helvetia, San Sebastian, Guatemala, in other collections.

Occemyia nigra Van Duzee

Oncomyia nigra Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 596.

Type: from Corvallis, Oregon, in Calif. Acad. Sci.,

Maine, Oregon, California.

Occemyia loraria Loew

Oncomyia loraria Loew, 1866, Centuriae VII, No. 74, pp. 101–2.
Oncomyia baroni Williston, 1883, Trans. Conn. Acad. Arts and Sci. 6: 97–98.
Oncomyia brevirostris Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 593.
Oncomyia aequalis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 594.
Oncomyia terminalis Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 594.
Zodion bimaculata Curran, 1933, Amer. Mus. Novitates, 673: 7.
Oncomyia frontalis Van Duzee, 1934, Ann. Ent. Soc. Amer. 27: 322.

Types: of *loraria* pair on pin with name label and two other pinned specimens all from New Hampshire with type label "446" in M. C. Z.; of *baroni* specimen labelled "Calif. Baron Type Wlstn. 443" in M. C. Z., 4 cotypes from Calif. in Snow Entomological Collections at Lawrence,

Kans.; of *brevirostris* holotype from Pullman, Wash., paratype from Mt. St. Helena, Calif.; of *aequalis* holotype from Lake Co. paratype from Marin Co., Calif.; of *terminalis* holotype from Hood River, Oregon, paratypes from Wash.; of *bimaculata* from Timagami, Ontario, in A. M. N. H.; of *frontalis* from Puyallup, Wash., all of Van Duzee's types in Calif. Acad. Sci.

Southern Canada and the United States.

Occemyia longicornis Say

Myopa longicornis Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 83.
Oncomyia infuscipes Van Duzee, 1927, Proc. Calif. Acad. Sci. 16: 592.

Types: of *longicornis* from "Missouri" is lost; of *infuscipes* holotype from Kearney, Ontario, allotype and paratype from Irving, Erie Co., N. Y., in the Calif. Acad. Sci.

Southeastern Canada and eastern United States west to Colorado, New Mexico and Arizona.

Occemyia modesta Williston

Oncomyia modesta Williston, 1883, Trans. Conn. Acad. Arts and Sci. 6: 96.

Types: one specimen labelled "Calif. Baron Type Wlstn 445" in M. C. Z., 3 cotypes from Washington Territory in the Snow Entomological Collections at Lawrence, Kans.

Southwestern Canada and western United States, east to Saskatchewan, Colorado, and New Mexico.

Occemyia luteipes Camras

Occemyia luteipes Camras, 1945, Ann. Ent. Soc. Amer. 38: 220–1.

Types: holotype and allotype from Pullman, Washington, in Calif. Acad. Sci., one paratype No. 26685 from Tooele, Utah, in the M. C. Z.; other paratypes from Calif., Wash., Idaho, Utah, and Col., in various collections.

Occemyia abbreviata Loew

Oncomyia abbreviata Loew, 1866, Centuriae VII, no. 73, pp. 101.
Oncomyia modesta var. *melanopoda* Williston, 1885, Trans. Conn. Acad. Arts and Sci. 6: 96, 393.

Types: of *abbreviata* Loew 2 cotypes No. 444 from Washington, D. C., in M. C. Z.; of *melanopoda* a cotype from Jefferson, N. H., and a cotype from White Mts., N. H., in the Snow Entomological Collections at Lawrence, Kans.

Southeastern Canada and eastern United States west to South Dakota.

Genus **Sicus** Scopoli

Scopoli, 1763, Ent. Carn., p. 369.

Genotype: *Conops ferruginea* Linn., the first of two species, by designation of Coquillett, 1910. Proc. U. S. Nat. Mus. 37: 605.

Synonym: *Cylindrogaster* Lioy, 1864.

Sicus has been included in the New World fauna but is here excluded and is confined to the Palaeartic region. Of the two recorded New World *Sicus*, *brevirostris* Coq. is discussed under *Robertsonomyia palpalis* (Robertson) of which it is a synonym, and *ciliatus* Van Duzee (1927, Proc. Calif. Acad. Sci. 16: 599–600. St. Paul Island, Alaska) belongs in the family Scatophagidae according to Camras (in litt.) who examined the unique male type in the Calif. Acad. Sci.

Genus **Stylogaster** Macquart

Macquart, 1835, Hist. Nat. des Insectes. Dipteres, 2: 38, pl. 13, fig. 15.

Genotype: *Conops stylata* Fabr. monobasic.

Synonyms: *Stylomyia* Westwood. 1850; *Ptychoproctus* Bigot, 1859.

The New World members of this genus have been revised by Aldrich, 1930, Proc. U. S. Nat. Mus., Vol. 78, Art. 9, pp. 1–27.

Ocellar triangle opaque, long, almost or quite reaching the lunule, third antennal segment three or four times the length of second.............. **neglecta** Will

Ocellar triangle shining, much shorter, rarely extending a little beyond middle of front, second and third antennal segment about equal in length, **biannulata** (Say)

Stylogaster neglecta Williston

Stylogaster neglecta Will., 1883, Trans. Conn. Acad. Arts and Sci. 6: 91–92, pl. 61, fig. 8.

Type: one specimen from Connecticut labelled "Type Wlstn 450" in M. C. Z. and one cotype each from Connecticut and Pennsylvania in the Snow Entomological Collections at Lawrence, Kans.

The M. C. Z. has a series taken on flowers of *Cephalanthus*, *Eupatorium purpureum*, and *Clethra alvifolia*, ranging from Massachusetts to Virginia, also Pinaleno Mts., Arizona. Aldrich recorded it also from Indiana and Onaga, Kansas.

Stylogaster biannulata (Say)

Myopa biannulata Say, 1823, Journ. Acad. Nat. Sci. Philad. 3: 81.
Myopa stylata Wied., 1830, Auss. Zweifl. Ins. 2: 243. Röder, 1892, Wien. Ent. Zeit. 11: 287.
Stylogaster stylata Macq., 1843, Dipt. Exot. 2: 18, in error.
Stylomyia confusa Westwood, 1850, Proc. Zool. Soc. Lond. 18: 269–270, pl. 19, fig. 4.

Types: of *biannulata* from Pennsylvania is lost; of *stylata* Wied. from Pennsylvania (probably a cotype), and Brazil (another species) in the Vienna Museum; of *confusa* from an unknown locality in the British Museum.

The M. C. Z. has *biannulata*, taken on *Helianthus strumosus*, from New Jersey, Delaware, Florida, and Mississippi. Specimens have also been examined from Kingston, Rhode Island (New England Mus. Nat. Hist.), South Meriden, Conn. (Conn. Agr. Exp. Sta.), and Chichenitza, Yucatan, Mex. (A. M. N. H.). Aldrich recorded it also from Indiana and Texas.

NOTES ON THE PHLEBOTOMUS OF PANAMA
(Diptera, Psychodidae)

III. P. CRUCIATUS COQ., TRINIDADENSIS NEWST. AND GOMEZI NITZ.[1]

G. B. FAIRCHILD[2] AND MARSHALL HERTIG[3]

The three species treated in the present paper are considered together because two of them, *cruciatus* and *trinidadensis*, have been confused with each other for many years, while *cruciatus* and *gomezi* are closely related man-biting species likely to be confused with one another. *P. cruciatus* does not occur in Panama, but is included for comparison with *gomezi* and to clarify its status.

Phlebotomus cruciatus Coquillet

1907, Ent. News, *18*, p. 102 (♀; Cacao, Trece Aguas, Alta Vera Paz, Guatemala). Haseman, 1907, Trans. Amer. Ent. Soc. *33*, p. 322. Summers, 1913, J. London Sch. Trop. Med., *2*, p. 115. Shannon, 1913, Proc. Ent. Soc. Washington, *15*, p. 166. Larrousse, 1921, Etud. Syst. Med. Phleb., pp. 64, 74. Shannon, 1926, Journ. Wash. Acad. Sci., *16*, p. 193, fig. 5 (♀ cerci). Not *Phlebotomus cruciatus* Dyar (1929) and others. (The extensive references to the name listed by Barretto (1947), other than those here cited, are to *trinidadensis* Newst. in whole or in part, following Dyar.)

This species has been long misunderstood. Only Shannon and Dyar, aside from the original describer, had access to material, and the latter by associating males of another species completely submerged the true identity of *cruciatus*.

We have recently had the opportunity of examining the type material of this species at the U. S. National Museum. The Types consisted of five females from Cacao, Trece Aguas, Alta Vera Paz, Guatemala, collected April 2, 15, 18 and 26, 1906, by Messrs. H. S. Barber and E. A. Schwarz. Of these, two specimens appear to have been mounted, but only one of these shows the structure of spermathecae and cibarium. We have measured both specimens and made camera lucida drawings of the cibarium, pharynx and spermathecae of the one which shows these structures (Slide No. 5051, labeled as Paratype).

The original description of this species is wholly inadequate, and has led others to regard the name as a *nomen nudum*. The description reads as follows: "Same as *vexator*, except that the hairs are chiefly yellow and the first submarginal cell is about three times as long as its petiole. Male unknown."

Mr. H. S. Barber, one of the collectors, records the species as a severe biter (Proc. Ent. Soc. Washington, *8* (3–4), p. 102, 1906 (1907),

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and one of us in conversation with Mr. Barber on 16 Jan., 1946, elicited the information that he and Mr. Schwarz took the type specimens on several occasions, once biting in the jungle in the daytime, and at other times resting on the outside walls of a house at night where they were collecting other insects attracted to a lantern inside the screen door of the house.

On page 107 of the same number of the Proc. Ent. Soc. Washington there is a photograph of the type locality, which is stated to be at an elevation of about 900 ft. and in heavy rain forest.

We have recently received a number of specimens of *Phlebotomus* from various localities in Mexico through the courtesy of Dr. Luis Vargas. This material consists of 3 females from Tapachula, 2 females from Arroyo Expangale, Tabasco, 7 females from Finca El Vergel, Chiapas, 1 female from Tamazunchale, San Luis Potosi and 1 female from Guadelupe, Zaju, Chiapas. Other material sent us at the same time from Tapachula, Chiapas, and Matamoros, Campeche, was already mounted, but not well enough to make out the necessary details of structure, although we suspect they are the same species. The first fourteen specimens, mounted by us, agree very closely in the structure of the spermathecae with *cruciatus*, and we are inclined to believe they represent that species. Measurements of wing and palpi and structure of the cibarium also agree. Finally, one of us collected a single female from buttresses of a hollow tree in heavy forest in the lowlands of Guatemala near Esquintla which agrees closely with the Types and the Mexican material. We have seen then, at least fifteen females of what we believe to be true *cruciatus*.

TABLE I

MEASUREMENTS IN MICRA

	P. gomezi, Panama.						*P. cruciatus*, Mexico and Guatemala.				
	Maximum		Minimum		Mean		Maximum	Minimum	Mean	Types	
	♂	♀	♂	♀	♂	♀	♀	♀	♀	♀	♀
Ant. III	332	300	300	240	314	273	308	264	286	273	318
Palpi I + II	224	216	172	184	196	202	220	176	203	184	215
Palpi III	208	200	172	176	187	187	192	168	178	174	175
Palpi IV	148	140	120	116	133	130	148	128	136	105	140
Palpi V	424	440	240	240	358	352	456	240	358	347	300
Head height	280	288	256	260	268	276	280	248	265	397	433
Clypeus	140	148	116	132	126	139	132	120	126	.....	.....
Proboscis	284	348	240	296	264	327	312	248	287	290	314
Eye height	240	236	208	208	224	219	232	200	214	.....	.....
Wing length	2120	2080	1800	1850	1960	1970	2080	1830	1940	1790	2000
Alpha	612	648	504	504	550	568	558	396	502	447	546
Beta	288	278	216	180	237	234	306	216	259	249	278
Gamma	288	324	216	216	244	270	342	252	293	264	315
Delta	216	234	126	108	165	176	162	72	102	84	104

On comparing this material and our drawings and notes on the Types with specimens of *P. gomezi* Nitz. 1931 (= *P. suis* Rozeboom, 1940) from Panama, we find no essential differences in measurements of palpi and wings. Although *delta* and *alpha* appear to average somewhat shorter in *cruciatus* than in *gomezi*, the measurements of individual specimens overlap, as shown in Table I. The spermathecae of *cruciatus* (Pl. I, figs. 5, 6) are of the same type as those of *gomezi* (Pl. I, figs. 2, 3) but the ducts are considerably shorter and thicker in *cruciatus*, and there is less contrast in the diameter of heads and ducts than in *gomezi*. The cibaria also appear to differ consistently. In *cruciatus* (Pl. I, fig. 4) the chitinous arch is well marked, complete, rather flat and quite distant from the teeth, while in *gomezi* it tends to be incomplete or very faint in the middle, more arched, and considerably closer to the teeth in Panama specimens. Barretto (1946) shows a complete but pointed arch for a specimen from Venezuela.

A further difference is to be seen in the structure of the cerci and the ninth tergite. In *cruciatus* the cerci (Pl. II, fig. 6) are very long and slender and bear three long stout hairs on the ventral side near the base. In *gomezi* the cerci (Pl. II, fig. 7) are shorter and more angled, but bear the same stout hairs. The ninth tergite of *cruciatus* (Pl. II, fig. 5) shows a curious papillate and heavily sclerotized area on the lateral anterior margin of the segment, entirely lacking in *gomezi*. Its degree of development varies in our material, but it is always present.

It is our opinion that these two forms may eventually prove to be races of a single species, but since we have no material from the extensive intermediate area, and the forms are distinguishable, it seems best to retain them as separate species for the present.

In regard to possible males of *cruciatus*, we have four males taken in company with the above mentioned female from near Esquintla, Guatemala. They are not distinguishable with certainty from males of *gomezi* from Panama, though our material is not in the best condition. The parameres appear somewhat more slender and the genital filaments slightly heavier than in Panama males, but the differences may be due to accidents of mounting. The figure of the paramere of *gomezi* given by Barretto (1946) differs to about the same degree from the appearance of Panama material as do the Guatemala males, but in an opposite direction, the Panama specimens showing an approximately intermediate condition.

The fact that the Types of *cruciatus*, and some of our Mexican material also, were taken biting man, is a further suggestive bit of evidence, as *gomezi* is one of the two species commonly taken biting man and other large animals in Panama. The Type of *gomezi* was taken in a lighted room in Venezuela, but we can find no published statement that it is a man-biting species in Venezuela, French Guiana or Brazil.

In regard to the identity of *suis* and *gomezi*, we accept provisionally their synonymy, although it may be well to point out certain discrepancies in the description of Venezuelan and Panamanian material. In his figure of the female cibarium, Barretto (1946, fig. 9) shows a high and rather pointed chitinous arch, while Panama material as figured by Rozeboom (1940) shows the arch evenly rounded and faintly or not at

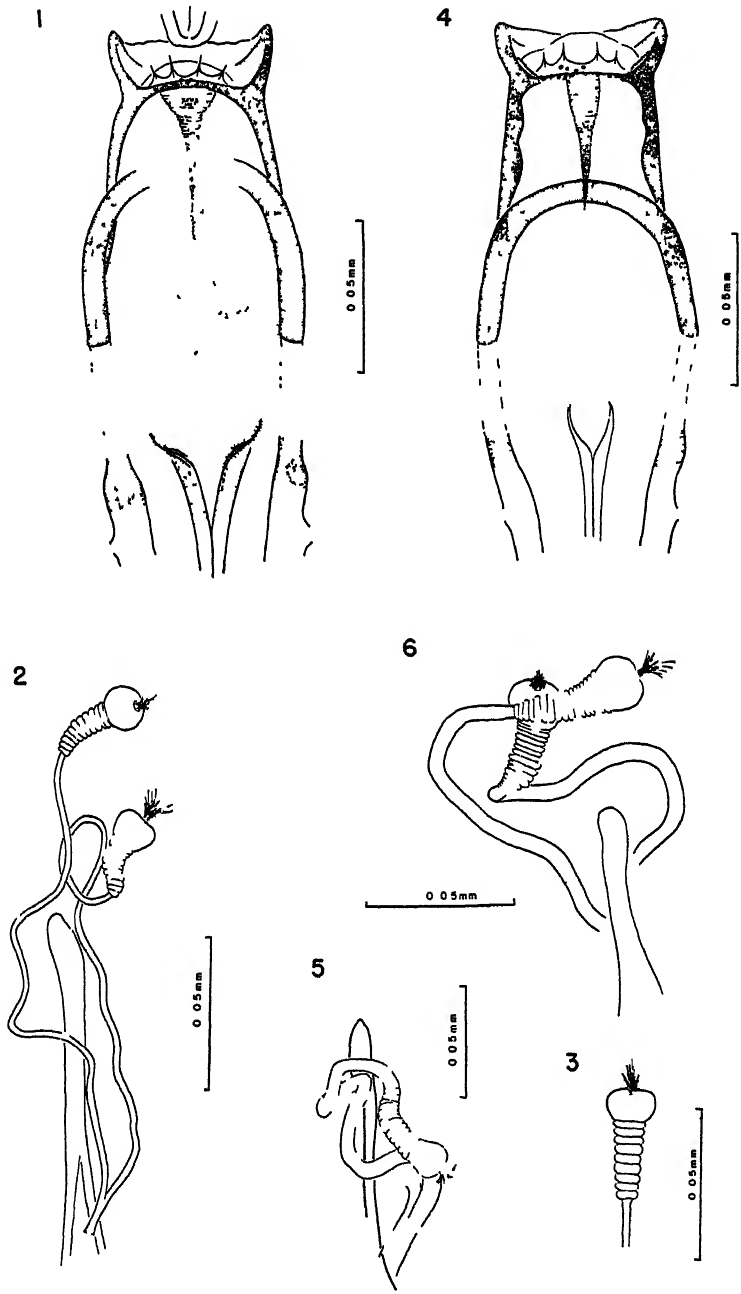
all visible centrally. We find both conditions and intergrades in our material, heavily stained specimens showing the arch practically continuous. A further character of possible importance in the cibarium of Panamanian *gomezi* is the prominently pigmented floor of the cibarium. This pigmentation begins abruptly just distal to the chitinous arch and fills out the distal two-thirds of the cibarium. We have noted this character in other species though it seems to have been overlooked by previous workers. It is best seen in unstained mounts, heavy staining obscuring the condition. Nitzulescu's (1931) figure of *gomezi* also shows a high and rather pointed arch. Barretto's figure shows two small lateral supplementary horizontal teeth in the cibarium, also shown by Nitzulescu, but not shown by Rozeboom nor seen by us, though we have seen material with a single supplementary tooth. In regard to Barretto's figure of the male, he shows a more clubbed paramere than any we have seen from Panama, the genital filaments in his specimen were apparently considerably more slender than in ours, and his basal tuft does not show the raspberry-like cluster of individual hair bases and the rather spreading habit of the tuft which seem quite characteristic of Panama material.

It might be well to point out also that *P. diabolicus* Hall from Texas appears to be quite closely related to *cruciatus* and *gomezi*. The male genitalia are very similar indeed to those of *gomezi*, and without material for comparison we are unable to point out valid differences. The differences indicated by Rozeboom (1940) in his description of *suis* apparently do not hold, as Hall's figure (1936) of *diabolicus* seems to have been misleading. Addis (1945) redescribed and figured *diabolicus* from topotypical material compared with the Types, and his figure of the genitalia shows no differences of importance from *gomezi*. The female of *diabolicus* described and figured by Addis differs from both *cruciatus* and *gomezi* in having six spines in the cibarium. It further differs from *cruciatus* in apparently lacking the papillate area on the ninth tergite and in more slender spermathecal ducts. However, the figure of the head of the spermatheca given by Addis is not entirely convincing, and may have been drawn from a shrunken specimen. The annulations are not clearly distinguished. From *gomezi* the female seems to differ further in having a well-marked chitinous arch and shorter spermathecal ducts. Measurements of wings, palpi, etc., show no significant differences between the three species, though *diabolicus* shows slightly shorter palpi and a slightly longer *gamma* than do the other two.

Both *gomezi* and *cruciatus* may occasionally show one or two small supernumerary teeth at the side, in the cibarium, and it is possible that *diabolicus* may eventually prove to be but a well-marked subspecies of

EXPLANATION OF PLATE I

Fig. 1 Cibarium of *P gomezi* ♀ from Panama (Slide 833). Fig. 2. Spermathecae of *P. gomezi* from Panama, drawn in phenol. Fig 3. Spermathecal head of *P. gomezi* from Panama showing maximum expansion, drawn in phenol Fig. 4 Cibarium of *P. cruciatus* from Tapachula, Mexico (Slide 828). Fig 5. Spermathecae of *P cruciatus*, camera lucida drawing from a paratype, U S N M. 5051 Fig 6 Spermathecae of *P. cruciatus* from Tapachula, Mexico, drawn in phenol (Slide 827)


1
4
0 05mm
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2
6
0 05mm
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5
0 05mm
3
0 05mm

cruciatus, a statement which also holds for *gomezi*. The fact that *diabolicus* is also a man-biting species is especially suggestive. As things stand now, it would be impossible to separate from one another males of *gomezi* and *diabolicus*, or the presumptive *cruciatus* males which we have studied. The differences rest entirely on the females, so that if the advice of Mangabeira and Galindo (1944, p. 192) were to be literally followed it would be necessary to consider these forms as a single species.

Phlebotomus gomezi Nitzulescu

1931, Ann. Parasit. Hum. Comp., *9*, pp. 247–255, figs. 1–6; Pl. IV (♀; San Cristobal, Venezuela). Costa Lima, 1932, Mem. Inst. Osw. Cruz, *26*, pp. 67–68, figs. 83, 138 (♀; Venezuela). Bequaert, 1938, Carnegie Inst. Washington, Pub. No. 499, pp. 230, 233. Pinto, 1938, Zooparasit. Inter. Med. Vet., p. 152. Ortiz, 1942, Bol. Lab. Clin. Luis Razetti, *3*, p. 167. Floch and Abonnenc, 1945, Inst. Pasteur Guyane, Pub. No. 100, p. 9. Barretto, 1946, An. Fac. Med. Univ. S. Paulo, *22*, pp. 1–7, figs. 1–11 (=*suis* Rozeb. ♂, ♀; States of S. Paulo and Para, Brasil and Venezuela); 1947, Arq. Zool. Est. S. Paulo, *5*, p. 202. Ortiz, 1947, Bol. Lab. Clin. Luis Razetti, Ano VIII, Vol. XV, p. 520 (=*suis* Rozeb. States of Aragua, Barinas and Tachira, Venezuela).

Phlebotomus suis Rozeboom, 1940, Amer. J. Hygiene, *32*, (1), Sec. C, pp. 8–11, figs. 1–5, (♂, ♀; Las Guacas, Panama). Mangabeira, 1941, Mem. Inst. Osw. Cruz, *36*, p. 376 (♂; Aura, Belem, Para, Brasil). Floch and Abonnec, 1943, Inst. Pasteur Guyane, Pub. No. 62, p. 7. Fairchild, 1943, Amer. J. Trop. Med., *23*, p. 571 (Panama). Iriarte, 1944, Bol. Lab. Clin. Luis Razetti, *5*, p. 269–273 (Venezuela). Floch and Abonnenc, 1945, Inst. Pasteur Guyane, Pub. No. 100, p. 9; 1947, Bol. Ent. Venezolana, *6* (1), p. 13.

Phlebotomus japignyi Floch and Abonnenc, 1944, Inst. Pasteur Guyane, Pub. No. 83, pp. 2–5, fig. 2–3 (♂, ♀; near Cayenne, French Guiana, in cavities in trees); 1945, op. cit., No. 100, p. 9. Barretto, 1947, Arq. Zool. Est. S. Paulo, *5*, (4), p. 206. Floch and Abonnenc, 1947, Bol. Ent. Venezolana, *6*, (1), p. 13.

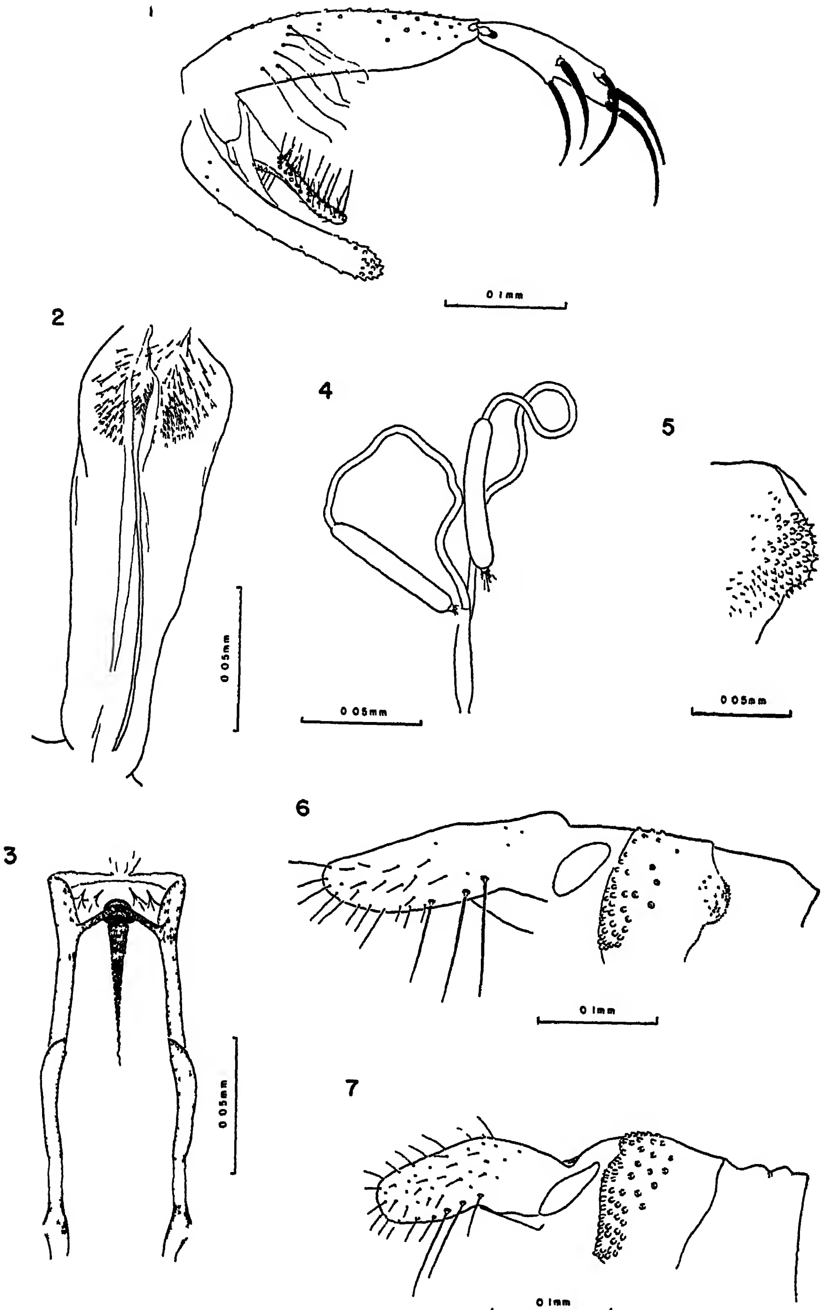
Phlebotomus trinidadensis Callan, 1947, Rev. Ent. *18*, (1–2), pp. 215–218.

In regard to *P. japignyi*, Floch and Abonnec (1944) distinguish their species from *suis* in the male by relatively slightly shorter genital filaments, fewer and shorter hairs in the basal tuft of the coxite (10 in *japignyi*, 15 in *suis*) and slight differences in the relative lengths of the palpal segments. In the female they distinguish their species from *gomezi* and from *suis*. Their comparison with *gomezi* is made from the drawings published by Nitzulescu, and is based on slight differences in lengths of the spermathecal ducts and pharynx and structure of the spermathecal head. The differentiation from *suis* rests on the presence of 10–12 annulations of the head of the spermatheca, while in *suis* there are said to be but 8. In addition, the annulations are said to be "crenelated" in *japignyi* but rounded in *suis*.

In our material of *suis*, both the length and number of hairs in the tuft on the base of the coxite varies, actual counts ranging from 10 to 17 or more. The palpal measurements, as seen in the table, also vary considerably. Our female *suis* generally shows 9 annulations,

EXPLANATION OF PLATE II

Fig. 1. Inner aspect of male genitalia of *P. trinidadensis* from Panama (Slide 134). Fig. 2. Pharynx of *P. trinidadensis* ♀ from Panama (Slide 880. Fig. 3. Cibarium of *P. trinidadensis* ♀ from Panama. Fig. 4. Spermathecae of *P. trinidadensis* from Panama, drawn in phenol. Fig. 5. Anterior margin of ninth tergite of *P. cruciatus* from Tabasco, Mexico, showing papillate area (Slide 1009). Fig. 6. Cerci and ninth tergite of *P. cruciatus* (Slide 1009). Fig. 7. Cerci and ninth tergite of *P. gomezi* from Panama (Slide 974).


1
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2
0.05mm
4
5
0.05mm
0.05mm
3
0.05mm
6
0.1mm
7
0.1mm

but there may be more. The "crenelated" or rounded aspect of the annulations in profile is due to accidents of mounting, fully expanded and unshrunken specimens having rounded annulations, while even slightly shrunken specimens show the annulations angular in profile. Fine details of structure in these organs are difficult to make out at best, and variations in mounting technique lead to quite a different appearance. We can duplicate the appearance of all published figures of *suis*, *gomezi* and *japignyi* in our material, and we believe all three names refer to but one species.

Dr. E. McC. Callan has recently published (Rev. Ent. 18, (1–2), pp. 215–218, 1947) a note on the habits of "*P. trinidadensis*" in Trinidad. Since the species is said there to attack man readily, we were considerably surprised, as we have never found it biting man, or indeed any other animal, in Panama. Dr. Callan was kind enough to send us a vial of specimens taken biting in Trinidad, and these on mounting have proven to be all *P. gomezi*, 11 ♀ and 1 ♂. Dr. Callan states that his material was determined by Dr. O. Theodor, and it is reasonable to assume that the latter felt he was dealing with the same species described and figured by him in 1932 (Bull. Ent. Res., 23, pp. 22–23, figs. 8c, d) as possibly *trinidadensis* Newst. As we will show later, Newstead's female types are at present indeterminate, though they may have been this species, and the name must be based on the male. Theodor's figure differs so much from the appearance of the material sent us by Dr. Callan that we are at a loss to understand his determination.

We have identified some 356 specimens of this species, mostly females. They have been taken in all months of the year, but our data are not complete enough to show seasonal fluctuations in abundance. Specimens have been seen from localities in Darien, Panama, Colon and Los Santos provinces, as well as from several localities in Costa Rica, so that the species probably is widely distributed in the Republic. The majority of our specimens have been secured from horse- or calf-baited mosquito stable traps, but a considerable number have been taken biting man, both outdoors and in houses, even in quite urban areas. Scattered specimens have been taken in a light trap, in crevices in masonry walls, hollow trees, and in the crevices between the buttressed roots of large forest trees. Males are decidedly scarce, most of ours having been taken accompanying females in stable traps or resting on persons accompanying the biting females. One of our associates, Mr. Pedro Galindo, has recently taken the species in some numbers resting on the walls of houses in Calzada Larga, a small village in the Madden Lake area, so it is probable that it is semi-domestic.

This species and *P. panamensis* are the two common man-biting species in Panama, being about equally abundant. We have records of two or three other species biting man or domestic animals, but they are of minor importance in most areas. The bites are sharp and painful, out of all proportion to the size of the insect, and on susceptible persons produce an itching papule which may persist a week or more.

In our experience, sandflies are not often abundant enough in Panama to cause much annoyance; we seldom catch more than a dozen or so per night in stable traps, and two or three per night is the

usual catch, although rarely we have seen as many as 200 taken from a single stable trap.

Phlebotomus trinidadensis Newstead

1922, Ann. Trop. Med. Parasit., *16*, (1), p. 4, fig. 1 (♂, ♀, Trinidad). Galliard, 1934, An. Parasit. Hum. Comp., *12*, (1), pp. 6–7. Mangabeira, 1942, Mem. Inst. Osw. Cruz, *37*, (2), pp. 200–201. Floch and Abonnenc, 1947, Bol. Ent. Venezolana, *6*, (1), p. 24.

Phlebotomus yucatanensis Galliard, 1934, An. Parasit. Hum. Comp., *12*, (1), pp. 1–7, figs. 1–3. (♂, ♀; Chichen Itza, Yucatan, Mexico). Op. cit., 1934, *12*, (3), pp. 200–201, fig. 5. Bequaert, 1938, Carnegie Inst. Washington, Pub. No. 499, p. 299 (in part).

Phlebotomus cruciatus Dyar, 1929, Amer. J. Hygiene, *10*, (1), p. 119 (♂, ♀; Panama). Costa Lima, 1932, Mem. Inst. Osw. Cruz, *26*, pp. 21–22. Hall, 1936, Proc. Ent. Soc. Washington, *38*, (2), p. 28 (♂). Galvão and Coutinho, 1940, Rev. Ent., *11*, (1–2), pp. 434, 437, Pl. I, fig. 11 (♀). Barretto, 1946, Rev. Brasil. Biol., *6*, (3), p. 433; 1947, Arq. Zool. Est. S. Paulo, *5*, Art 4, pp. 194–195 (in part). Not *P. cruciatus* Coquillet, 1907.

Phlebotomus yucatanensis var. *baduelensis* Floch and Abonnenc, 1941, Inst. Pasteur de la Guyane, Pub. No. 15 (♂); 1941, op. cit., Pub. No. 28, pp. 1–3, fig. 1 (♀).

Phlebotomus baduelensis Floch and Abonnenc, 1944, Inst. Pasteur de la Guyane, Pub. No. 90, pp. 1–4, figs. 1–2, (♂, ♀; French Guiana); 1944, op. cit., Pub. No. 95, p. 3, fig. 1c (anomalous ♂); 1945, op. cit., Pub. No. 100, p. 7, Pl. 2 (♀). Barretto, 1946, Rev. Brasil. Biol., *6*, (4), pp. 527–529.

Phlebotomus longipalpis Ristorcelli and Dao Van Ty, 1941, An. Parasit. Hum. Comp., *18*, (4-5-6), pp. 252–255, fig. 1 (♀; Narino, Colombia). Not *P. longipalpis* Lutz and Neiva 1912.

Phlebotomus villelai Mangabeira, 1942, Mem. Inst. Osw. Cruz., *37*, (2), pp. 196–201, figs. 131–146 (♂; Ceara and Para, Brasil).

Through the kindness of Mr. Paul Freeman we have been able to have Panama material compared with Newstead's Types at the British Museum. Mr. Freeman writes that the Types are not in very good condition and the staining is very faint. The male agrees with our material in details of the genitalia, including the hairs on the inner aspect of the coxite, and the genital filaments appear to be the same. Mr. Freeman was kind enough to measure the wings of the two males and a female from the type lot; his figures are included in the subjoined table (Table II). As will be seen, Newstead's specimens are rather smaller than the average of Panama specimens, but fall within the range of variation of our material. The palpi in the types are twisted and distorted, but Mr. Freeman believes they have the same structure and formula as our material. The female types were apparently not well cleared before mounting, and neither the cibarium nor spermathecae were visible. The wing measurements, however, fall within the range of variation of our series. Mr. Freeman was unable to make out the structure of the ascoids in the poorly stained types. We believe, therefore, that, at least in the case of the males, the above synonymy is correct. We are unable to consider the characters used to separate *baduelensis* Floch and Abonnenc, 1941 (= *villelai* Mangabeira, 1942) from *yucatanensis* Galliard of specific value as we believe that it is very probable that Galliard either overlooked the fine hairs on the inner aspect of the coxite or did not consider their presence worthy of mention. Even should a re-examination of Galliard's types prove their complete absence, their numbers are so variable in the material we have seen that we feel that at most they might be used to differentiate a geographic race or subspecies.

In the case of the females, little can be said. Remounting of Newstead's types would be of interest, but it might not prove that they were the same species as the male. The wing and palpal measurements are in fair agreement, but these characters are not definitive. Theodor's (1932, Bull. Ent. Res., 23, p. 22, fig. 8 c, d) description of females from Trinidad which he thought might be *trinidadensis* helps little, as his specimens were certainly not like the females which Galliard, Floch and Abonnenc and we have associated with *trinidadensis* males.

TABLE II

MEASUREMENTS IN MICRA

P. trinidadensis

	Panama Material								
	Maximum		Minimum		Mean		Cotype	Paratype	Cotype
	♂	♀	♂	♀	♂	♀	♂	♂	♀
Ant. III	260	240	200	196	228	221	....	....	....
Palpi I + II	144	148	112	120	130	136	....	....	....
Palpi III	148	152	112	136	131	140	....	....	....
Palpi IV	116	116	100	100	105	109	....	....	.. .
Palpi V	348	380	260	300	312	337	....	....	....
Head height	220	236	200	212	211	222	....	....	....
Clypeus	116	120	108	104	112	113	....	. ..	....
Proboscis	152	188	140	168	146	174	.. .	. ..	....
Eye height	176	196	156	168	165	182	....	....	..
Wing length	1650	760	1380	1670	1490	1710	1420	1540	1600
Alpha	342	486	288	396	277	437	260	300	372
Beta	306	288	216	234	248	268	224	210	310
Gamma	288	306	234	252	261	279	270	250	240
Delta	162	270	126	162	136	214	100	100	200

Dyar's synonymizing of *trinidadensis* with *cruciatus* was based on wholly insufficient data, as Galliard and Theodor pointed out. We have seen both the Types of *cruciatus* Coq. and material from Venezuela and Panama determined by Dyar as *trinidadensis*. Dyar's males at least were *trinidadensis* in the present sense.

The description of *P. longipalpis* Lutz and Neiva given by Ristorcelli and Dao Van Ty agrees very closely with our material, differing only in slightly shorter measurements for the palpi and a somewhat longer *delta*. The very characteristic cibarium and spermathecae lead us to believe that their single specimen was *trinidadensis*. Coutinho (1940, Rev. do Museu Paulista, 1, p. 334, figs. 8, 9) has figured material from Ceara near the type locality of *longipalpis* and his figures show a totally different species from that determined as *longipalpis* by Ristorcelli and Dao Van Ty.

P. trinidadensis is difficult to place in any group within the genus. The males seem closest to such species as *rorotaensis*, F. and A., *oswaldoi* Mang., *peresi* Mang. and *longipennis* Barr., in fact the differences between these species are slight indeed. This group grades into such species as *vexator* Coq. *noguchii* Shnn. and *stewarti* Mang. and Gal.

which have clearly marked non-deciduous hairs on the base of the coxite. Barretto (1946) has recently given a key to the males of species with five spines on the style. In the case of the females the picture is not at all clear. *P. oswaldoi* has been reared by Mangabeira (1942) and the female differs in important respects from females associated with the males of *trinidadensis* by Galliard, Floch and Abonnenc and ourselves, since it lacks the spinose pharynx, and has quite different spermathecae, though the cibarium is somewhat similar. Females thought to be those of *rorotaensis* by Floch and Abonnenc (1944, Inst. Pasteur Guyane, Pub. No. 90, p. 6, fig. 4) are very similar to those of *oswaldoi* Mang. and have been placed in the synonymy of the latter by Barretto (1947), though he retains the male as a distinct species. Floch and Abonnenc (1944) describe and figure, without naming, a female which they suspect may be the female of *peresi* Mang. This species has the pharynx and cibarium essentially as in *trinidadensis* Newst., and the spermathecae, though annulate, are of a similar shape. Putative females of the other species with 5-spined styles show widely different spermathecae, different cibaria and unarmed pharynges. As has often been pointed out, association of the sexes of *Phlebotomus* without actual bred material is always uncertain. In the case of the present species, however, this uncertainty seems to us small, and the rather unusual structure of the female cibarium and pharynx would seem to indicate a less close relationship to other species than might be postulated from the quite similar males.

The species has a wide range, being now definitely known from Brazil, Trinidad, French Guiana, Venezuela, Colombia, Panama and Yucatan. In Panama it is one of the most abundant species, having been taken in practically every month of the year and from a wide variety of habitats. It seems to be the dominant species in tree buttresses, where it outnumbers all other species combined. It has not been taken biting, or in animal baited traps,, nor is it an ordinary frequenter of animal burrows and bat trees, so that we have no hint as to its preferred hosts.

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Mangabeira, O., and **Galindo, P.** 1944. The Genus *Flebotomus* in California. Amer. J. Hygiene, 40, (2), pp. 182–198, Pl. I–III.

Rozeboom, L. E. 1940. *Flebotomus suis*, a new Flebotomus from Panama. Amer. J. Hygiene, 32, (1), Sec. C, pp. 8–11, figs. 1–5.

THE EFFECT OF TEMPERATURE ON THE FREQUENCY OF BEAT OF THE GRASSHOPPER HEART

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The effect of temperature on the rate of beat of the adult insect heart apparently has not been studied previously. However, there have been two investigations concerning the heart beat of nymphal cockroaches. Fries (1927) found a μ value of 12,500 for the heart of intact Blatta orientalis nymphs between 10° and 38°C. Steiner (1932) found that the heart beat of Periplaneta americana nymphs gives values of about 12,000 between 15° and 30°C in the intact animals, about 9,000 in decapitated but otherwise intact animals, and various values between 5,800 and 11,300 in decapitated animals in which the heart and / or ventral nerve cord had been severed in the mid region of the body.

The "accessory" hearts in the swimming legs of Notonecta have been studied by Crozier and Stier (1927) who found that the isolated legs between 6° and 19°C usually give μ values of 8,200, 16,200, or 32,200 but sometimes 11,400, 19,800, or 24,500. Such preparations are obviously not under control of the central nervous system.

The effect of temperature on heart beat frequency of insect larvae has also been investigated. Crozier and Federighi (1925) found a temperature characteristic of 12,200 for the intact silkworm between 6° and 36°. Koizumi (1928) found values of 7,500, 8,900, and 13,100 for Chironomus larvae, and later found values of 10,300 and 16,700 for Aedes and 10,700 and 15,400 for Mochlonyx (Koidsumi, 1931). With caddis fly larvae Federighi (1937) obtained a value of 12,500 between 2° and 20°C with one specimen, and 13,500 with four others.

Temperature characteristics have also been determined for the heart beat of other invertebrates. Adult intact Limulus usually gives a value of 12,200 and sometimes a higher value (23,500) below 15°C (Crozier, 1924; Crozier and Stier, 1927; from data of Garrey). However, in the embryo before the heart is innervated the values are 11,500, 16,400, 20,000, or 25,500. Asellus has a value of 32,000 between 6° and 16°C (Crozier and Stier, 1927) and Ciona, values of 8,000, 12,000, and 16,000 below 30°C. (Wolf, 1932).

The heteropod Pterotrachea has a value of 11,200 and the pteropod Tiedemannia one of 16,200 (Glaser, 1926). The heart of Anodonta has a value of 11,200 (Crozier and Stier, 1925, data of Koch). Freshly collected Limax yields values of 11,500 in December and 16,300 in March, but the December value can be raised reversibly to 16,200 by feeding sugar (Crozier and Stier, 1926). In Daphnia the μ value varies from 6,700 to 35,000 (Stier and Wolf, 1932). Other citations are given by Bělehrádek (1935).

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MATERIALS AND METHODS

The animals used in the present experiments were adult laboratory grown grasshoppers, Melanoplus differentialis. The grasshoppers were decapitated and opened from the ventral side, the digestive and reproductive systems and other outlying tissues were removed, and the dorsal tubular heart exposed. The rate of heart beat was measured from records of the electrocardiogram taken from these preparations. The heart was covered with Belar's solution, and four Ag-AgCl electrodes were placed in direct contact with the heart at four segmental levels, thereby furnishing dipolar input voltages for three channels of amplification. A fourth channel was used as a timing signal, and permanent records were made by an Offner Crystograph. The electrocardiogram of the grasshopper has been described previously (Jahn, Crescitelli, and Taylor, 1937; Crescitelli and Jahn, 1938).

The temperature chamber consisted of a bakelite box lined with coils of copper tubing. The temperature of the chamber was controlled by forcing hot or cold compressed air through the coils, and the temperature was measured with a mercury thermometer with the bulb at the level of the heart.

It was found that when the temperature was altered by 2°C the heart usually adjusted to the new rate within two minutes. Ordinarily the heart was maintained at each temperature for three minutes or longer. When the temperature was changed from one of the extremes back to room temperature, thirty minutes was necessary for a steady rate at room temperature to be established; forty minutes was usually allowed. Each preparation was subjected to a graded series of temperatures, beginning at room temperature and going to one extreme, either hot or cold, and the electrocardiogram was recorded at each step. The temperature was then changed to that of the room for forty minutes or longer. Sometimes there was a "hysteresis effect" in that the initial room temperature rate was not quite resumed upon return from either extreme back to room temperature. However, a few degrees beyond room temperature toward the other extreme the rate usually returned to an appropriate value. In these cases the temperature shift toward the other extreme was then continued and records were again made every few degrees. In other preparations the return to the initial room temperature rate was quickly established. No significant difference was noted between those subjected first to low and then to high temperatures as long as the temperatures did not go below 0°C or above 50°C.

RESULTS

The overall range of temperatures used was approximately 0° C. to 50–54° C. There was some variation in the temperatures at which the heart beat of individual preparations ceased to be recognizable from the electrocardiogram. Thus, in one of the animals, the beat became imperceptible at 7°; whereas for most, the heart maintained a beat between 0 and 1° with the rate reduced to about 10–12 beats per minute from an average of 65 at 27° C. The method of experimentation precluded the study of the effect of lower temperatures on the heart because of the freezing point of Belar's solution. However, since Belar's solu-

tion is approximately isotonic with the heart tissue the temperature at which the heart would cease (the "biological zero") is only slightly below 0° C. An interesting but unexplained phenomenon was the occasional degeneration of a beat which had been slow but strong at 0–5°, when the temperature was raised a degree or two in the first step toward return to room temperature. This effect was noted in several hearts, but the cause was not investigated.

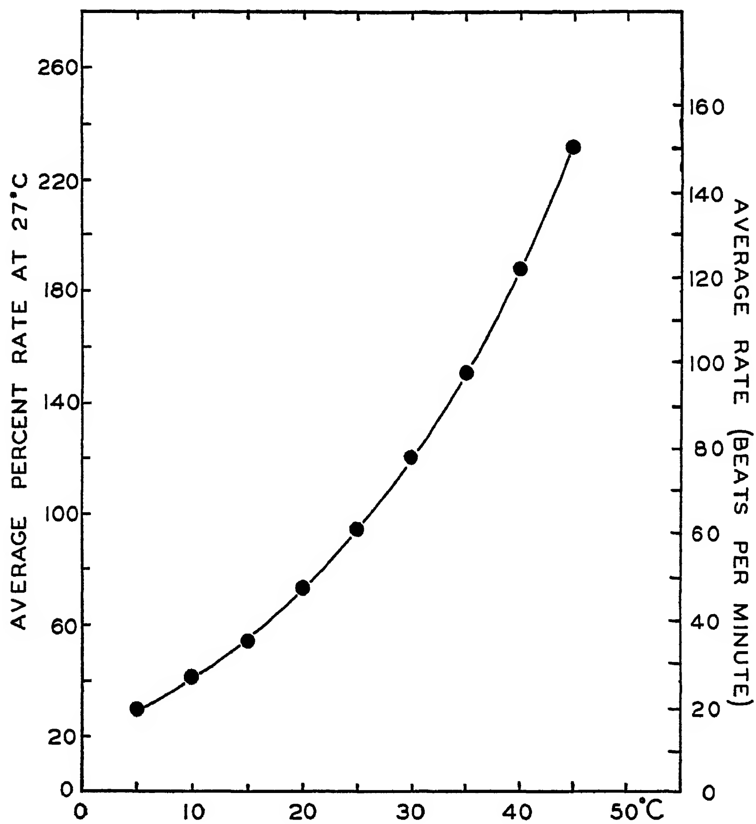

FIG. 1. The average rate of beat of twelve "typical" grasshopper heart preparations as a function of temperature. Ordinate on left in per cent at 27° C; ordinate on right in beats per minute.

At the upper end of the temperature range, there was as much variability in response. One heart degenerated irreversibly at approximately 40° while other hearts continued to beat above 50° and retained the ability to return to the initial rate at room temperature.

In the present study the heart rate as a function of temperature was determined for twenty-eight heart preparations. In twelve preparations the temperature range used was either room temperature to about 5° or room temperature to 40–50° C. For sixteen preparations the

range was more than 30°, usually 5–10° to 40–50°. The results of the short range experiments were within the limits of those of the long range experiments; therefore only the latter are considered in the present paper.

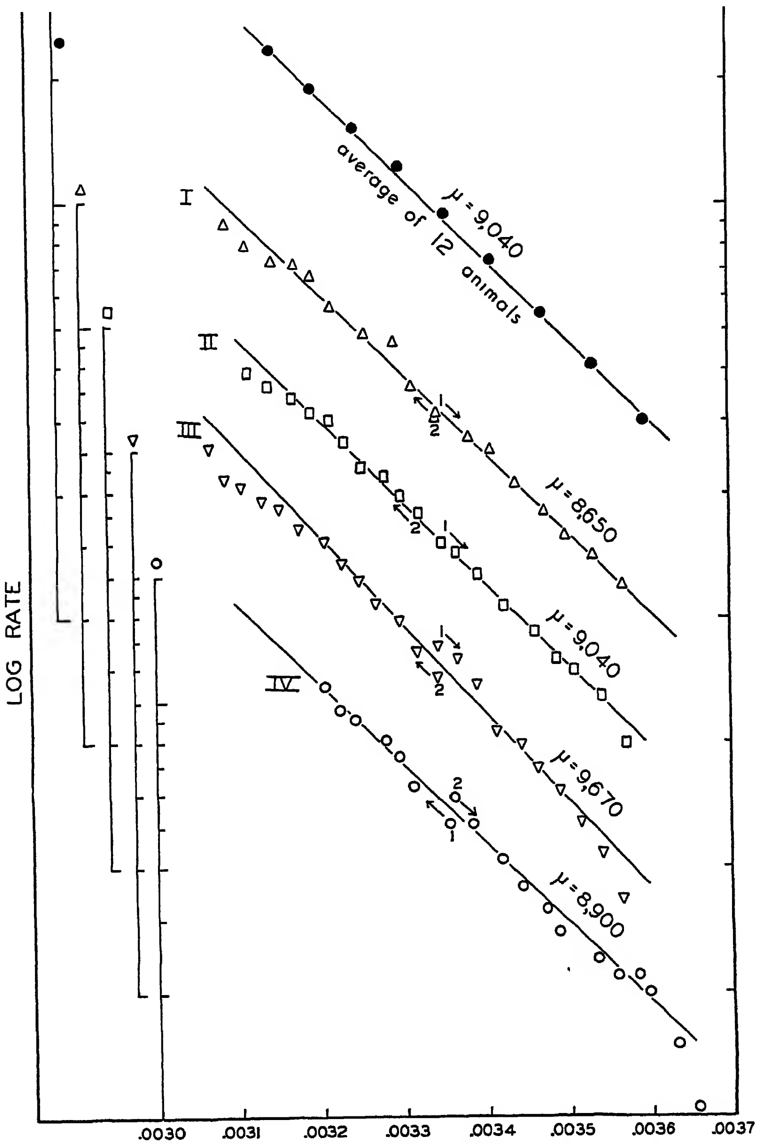

FIG. 2. Log of rate plotted against reciprocal of absolute temperature to test van't Hoff-Arrhenius equation. Upper curve: average of twelve preparations, date of fig. 1. Curves I to IV: individual data included in upper curve.

Of the sixteen preparations which were studied over a wide temperature range, twelve yielded fairly uniform results; so that it seemed permissible to average the data. The other four preparations yielded results which differed appreciably from the twelve "typical" experiments, and also from each other, so as to warrant separate treatment.

The results of the twelve typical experiments are summarized in fig. 1. The individual data for each experiment were plotted with rate against temperature. Then smooth curves were drawn through the

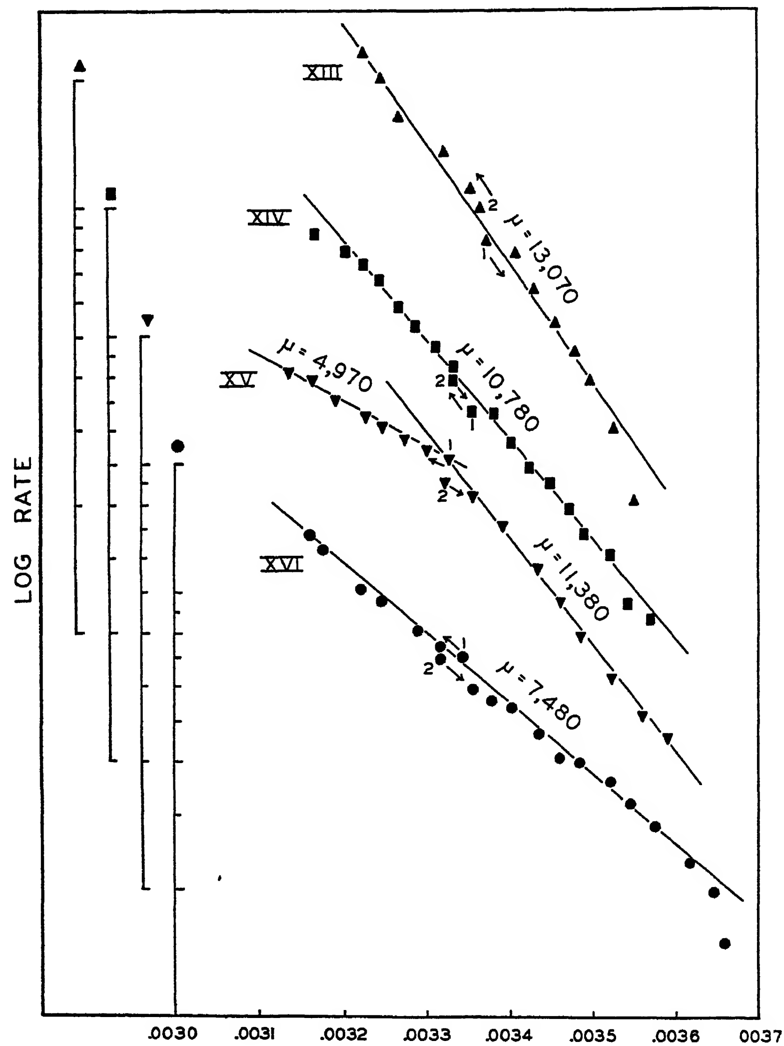

FIG. 3. Log of rate plotted against reciprocal of absolute temperature for four "atypical" preparations not included in the averaged date of fig. 1.

points and the value for 27° was interpolated. With this as 100% the other values were then replotted on a percentage scale and the value for each 5° interval between 5° and 45° was determined by interpolation. These average values are shown in fig. 1. The left-hand ordinate shows the percentage in terms of 27° and the right-hand ordinate shows the equivalent value in beats per minute, with sixty-five beats per minute, the average at 27°, taken as one hundred per cent. Individual rates at 27° varied from 55 to 80. This graph shows the trend of average data.

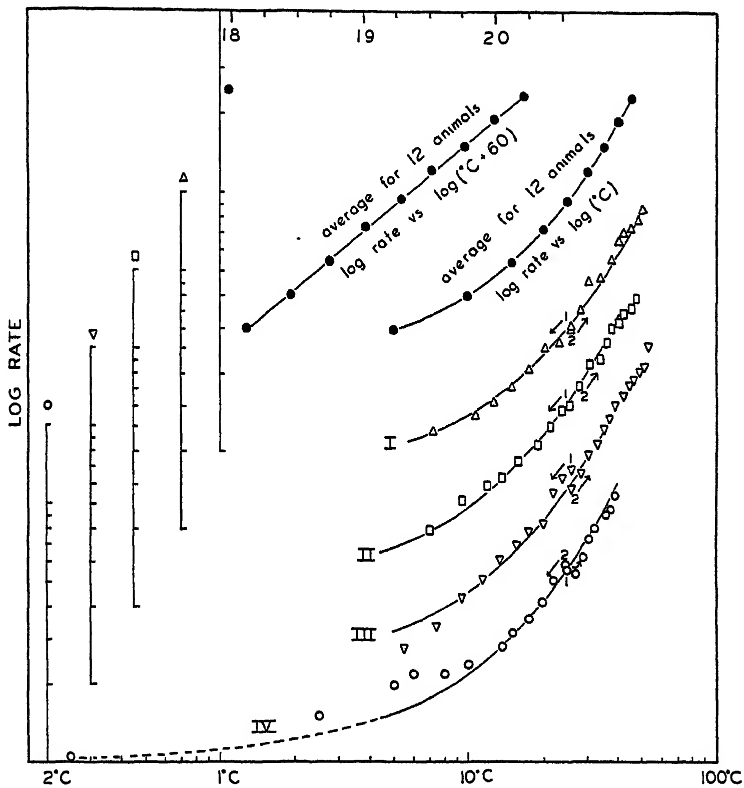

FIG. 4. The five lower curves are the same data as fig. 2, plotted as log rate against log Centigrade temperature to test Bělehrádek equation. The uppermost curve is log rate plotted against °C + 60 to test Bělehrádek equation with "biological zero" of —60° C.

Fig. 2 shows the log of the rate plotted against the reciprocal of the absolute temperature for the purpose of testing the fit of the van't Hoff-Arrhenius equation. Represented on this graph are individual data for four of the twelve typical experiments and also the average from fig. 1. The four sets of data shown are typical of the series of twelve and show some of the variation encountered. On the graph the small numbers 1 and 2 and the neighboring arrows denote the direction in which

the temperature was changed. In curve 1 the first point obtained is labelled "1," and the arrow denotes that the temperature was lowered. After the rate at the lowest temperature was determined the temperature was raised to approximately room temperature, the point labeled "2" was obtained, and subsequently those at higher temperatures. All of the typical data are fitted quite well by single straight lines except for the extremes where the points tend to fall below the line. The data, however, are not adequate to warrant the fitting of separate lines for the extremes. Curves I and III with μ values of 8,650 and 9,670 represent the lowest and highest values that were averaged to order to obtain the average value of 9,040 typified by curve II. The points for the averaged data show a slight curvature, but they are closely approximated by a straight line between 5° and 45°.

Fig. 3 shows the data from four experiments which seemed consistent within themselves but which differred sufficiently from those of figs. 1 and 2 to warrant separate presentation. Most of the data for three of these preparations can be represented by single straight lines, two with μ values above average (XIII and XIV) and one below (XVI). The data for preparation XV are best represented by two straight lines of slope 4,970 and 11,380.

Fig. 4 shows the same data as does fig 2, i. e., the average and the "typicals", except that, for the purpose of testing the Bělehrădek equation, the points are plotted in a different manner. For the five curved lines the data are plotted as log rate against log temperature in degrees Centigrade. The curves drawn through the individual data (Curves I to IV) have the same slope and curvature as that drawn through the average for the twelve typical preparations. If the simpler form of Bêlehrádek equation (with "biological zero" equal to zero Centigrade) were applicable, these curves would be straight lines; obviously they are not.

The Bělehrádek equation can be made to fit certain other data (e. g., photosynthesis of Prunus, see Bělehrádek, 1935) by assuming a biological zero somewhat different from zero Centigrade. However, in order to convert the curves of fig. 4 into straight lines by this method it is necessary to assume a biological zero about −60°C. The effect of such a calculation is shown at the top curve of fig. 4 where log rate is plotted against log (°C + 60). The lowest temperature at which the grasshopper heart will beat has not been determined experimentally, but it is certainly very much closer to 0°C. than to −60°C. The "calculated" "biological zero" of −60°C is probably of no value except to prove the inapplicability of the Bělehrádek equation to the present data.

Q_{10} values calculated from the averaged typical data of fig. 1 are as follows:

Temperature range	Q_{10}
5–10° C.	1.83
10–15° C.	1.78
15–20° C.	1.80
20–25° C.	1.67
25–30° C.	1.64
30–35° C.	1.58
35–40° C.	1.55
40–45° C.	1.52

It is apparent from these values that there is a gradual decrease of Q_{10} with increase of temperature from a maximum of 1.83 for 5-10°C to 1.52 for 40-45°C

DISCUSSION

Most of the interest in the effect of temperature on heart beat frequency has centered around the following questions:

1) Does the change in frequency with temperature follow the van't Hoff-Arrhenius equation? Usually yes, (cf., however, Bĕlehrádek, 1929, 1935)

2) Does the temperature characteristic change with removal of all or part of the central nervous system? Yes, at least in some instances, e. g., cockroach (Steiner, 1932).

3) Can the value of the temperature characteristic be used to indicate whether the beat is neurogenic or myogenic? Indicative but equivocal. The value 12,000 is often encountered in invertebrate nervous systems, and also in the heart when under nervous control. However, this value also occurs elsewhere, and if it has a real meaning it is probably more indicative of a particular metabolic process than of the histological type of tissue.

4) Can the μ value be changed by methods which do not involve removal of the influence of the nervous system? Yes, e. g., in Limax the value can be changed reversibly from 11,500 to 16,300 by feeding of sugar (Crozier and Stier, 1926).

5) Are the μ values the same for different processes in the same animal? That is, is there a central control of all μ values? Not necessarily, e. g., in Daphnia the μ values for both heart beat and respiratory movements vary from 6,500 to 30,000 or more, and there is no obvious relationship between them, i. e., the ratio of the two μ values varies from one individual to another (Stier and Wolf, 1932). In Asellus between 4° and 15°C the value for heart beat is 32,300 and that for gill movements only 16,000 (Crozier and Stier, 1927).

The very intriguing question of what effect different values for closely related phenomena such as heart rate and respiratory movements would have on the chemical equilibria of the animal's blood or other tissues has not been the subject of investigation.

The only published experiments which seem to have a direct bearing on the present ones are those of Fries (1927) and Steiner (1932) on the cockroach heart. Both of these investigators found μ values of about 12,000 for intact animals. In addition Steiner (1932) found that decapitated but otherwise intact animals gave μ values of 8,500-9,000; section of the nerve cord or heart at the thoraco-abdominal junction of decapitated animals raised these values to 10,000-11,000; electrical stimulation of the neck, however, lowered the values for the thorax to 5,800-7,400, but not those for the abdomen.

Steiner's values for decapitated but otherwise intact cockroaches are within the limits of the twelve "typical" heart preparations of the present data. However, since no data on intact grasshoppers are available it is impossible to state whether this similarity of values is coincidental or is caused by a similarity in the metabolic processes of the two hearts.

The respiratory rate of Melanoplus yields μ values of 7,900 when the

animal is intact and 16,500 or 11,300 when decapitated (Crozier and Stier, 1925a). Comparable values for the heart are not available.

It is obvious from figs. 2, 3, and 4 that the van't Hoff-Arrhenius equation describes the present data much better than does that of Bĕlehrádek. The fact that the data can be fitted by the Bĕlehrádek equation if the absurd value of −60°C for "biological zero" is assumed should serve as adequate warning against such a procedure unless the real value of "biological zero" has been determined experimentally.

SUMMARY

1. The rate of beat of the grasshopper heart has been determined from electrocardiograms of preparations consisting of the tubular heart and the body wall of the thorax and abdomen.

2. The average rate varies from 20 beats per minute at 5° to 150 at 45°C. Near zero the heart slows to about 10 beats per minute. Above 45° the rate continues to rise at least as high as 53°C.

3. Most of the data can be fitted quite well by the van't Hoff-Arrhenius equation with a μ value of about 9,000, but not by the Bĕlehrádek equation unless the absurd value of −60°C is assumed for the "biological zero". Four typical preparations yielded μ values of 5,000 to 13,000.

4. Q_{10} values decrease with rising temperature from 1.83 at 5−10°C to 1.52 at 40-45°C.

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A REVISION OF THE NORTH AMERICAN ANTS OF THE GENUS MYRMICA LATREILLE WITH A SYNOPSIS OF THE PALEARCTIC SPECIES. II.

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Swarthmore College,
Swarthmore, Pa.

The preceding part with this title was published in the Annals of the Entomological Society of America, September, 1947 (40: 437–474, 3 text figs.). It treated the genus as a whole (keys, distribution, affinities, etc.) and thirteen species comprising fifty described forms. The species were palearctic except for three forms of *Myrmica laevinodis* Nylander found in three localities on the east coast of North America which were probably importations in historic times.

The present part deals with seven species comprising fifty-four described forms. Seven of the latter are nearctic and include three of the common ants of North America (*Myrmica lobicornis fracticornis* Emery, *M. sabuleti americana* Weber and *M. schencki emeryana* Forel). They are North American equivalents of common Eurasian species. Locality lists of these are included and a brief account of their biology, variations and anomalies.

THE HOLARCTIC SPECIES OF MYRMICA LATREILLE (Continued)

Myrmica sulcinodis Nylander

M. Sulcinodis Nylander, Acta. Soc. Sc. Fennicae, 1846, *2:* 934–935, ☿ ♀; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 86–88, fig. 3, ☿ ♀ ♂; Karawajew, Konowia, 1926, *5:* 283; Starcke, De Levende Natuur, 1927, 13; Kuznetzov-Ugamskij, Zool. Anz., 1929, *83:* 45.

Worker (after Nylander): Length ca. 2 lin.

In general, similar to the preceding (*M. lobicornis*), but paler, antennal scapes and pedicel otherwise formed. Frontal area obscured, traversed by striae. Frontal laminae a little less dilated below the margins. Antennal scapes a little curved at the base, nevertheless more than in *M. laevinodis.*

. Epinotal spines very long, subulate. Pedicel longitudinally sulcate with coarse sulcations, about 12 in number and regular (not confused as in *laevinodis*).

Female (after Nylander): Length 2½ lin.

Similar to the preceding female (*laevinodis*) with the differences noted in the worker. Head as in the worker. Epinotal spines long, subulate, slightly curved. Pedicel laterally, regularly and deeply sulcate. (Wings absent).

Male (after Emery): Length 5–5.5 mm.

Color as in *rubra*; sculpturing rougher and thicker; the entire thorax dull and striate; petiole wrinkled, somewhat dull; part of the postpetiole

shining. Antennae more slender than in *M. rubra*, the scape not quite half as long as the funiculus (equal to the 6 following joints together); club indistinctly 4–5-jointed.

Distribution: Northern Europe and Asia and in the Pyrenees, Alps, Apennines, Balkans and Caucasus.

Myrmica sulcinodis subsp. nigripes Ruzsky

M. sulcinodis var. *nigripes* Ruzsky, Berlin. Ent. Zeitschr., 1896, *4:* 73, ☿ ♀ ♂; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 88.

Worker (after Ruzsky):

Differing from the typical form mainly through the black or blackish brown legs; tarsi light, color in general darker, the body more wrinkled.

Type Locality: Orenburg Urals: High ridge of the Kumatsch.

"Males and females in July" (not described).

According to Emery the worker thorax is ferruginous, the head, pedicel and gaster blackish brown, the antennae and legs brown; the sculpturing is stronger and more regular than in the type; the petiolar node somewhat shorter.

The male is darker and more strongly sculptured than in the type; the petiole is more strongly furrowed longitudinally, the postpetiole thickly punctate, dull.

Emery lists South Russia and West Siberia.

Myrmica sulcinodis var. sulcinodo-ruginodis Forel

M. sulcinodis var. *sulcinodo-ruginodis* Forel, Fourmis Suisse, 1874: 77, ☿; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 88.

Forel erected this name for the ants intermediate between *sulcinodis* and *M. rubra* (=*M. ruginodis*).

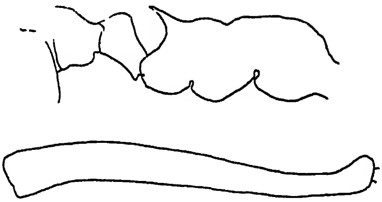
Myrmica sulcinodis var. sulcinodo-rugulosa Nassonov

M. sulcinodis var. *sulcinodo-rugulosa* Nassonov, Trav. Lab. Zool. Univ. Moscow, 1889, *4:* 35, ☿.

Similarly erected by Nassonov for the ants intermediate between *sulcinodis* and *M. rugulosa*.

EXPLANATION OF PLATE I

Fig. 1. Body outline and antennal scape of the worker of *Myrmica laevinodis* var. *bruesi* Wheeler. Fig. 2. Body outline and antennal scape of the worker of *Myrmica scabrinodis* subsp. *mexicana* Wheeler. Fig. 3. Body outline and antennal scape of the worker of *Myrmica lobicornis* subsp. *fracticornis* Emery. Fig. 4. Body outline and antennal scape of the worker of *Myrmica sabuleti* subsp. *americana* Weber. Fig. 5. Body outline and antennal scape of the worker of *Myrmica sabuleti* subsp. *hamulata* Weber. The lamina at the bend of the scape is prolonged into a hook is diagnostic. Fig. 6. Body outline and antennal scape of the worker of *Myrmica sabuleti* subsp. *nearctica* Weber. The lamina at the bend of the scape extends farther than in *americana*. Fig. 7. Body outline and antennal scape of the worker of *Myrmica schencki* subsp. *emeryana* Forel. Fig. 8. Body outline and antennal scape of the worker of *Myrmica schencki* subsp. *tahoensis* Wheeler.



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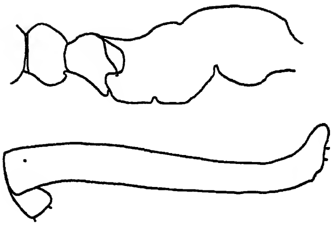

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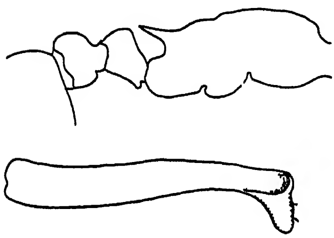

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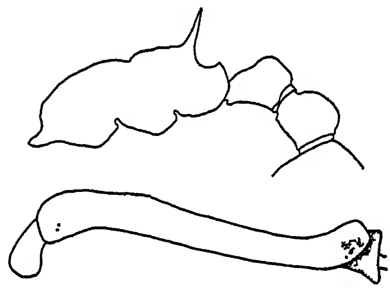

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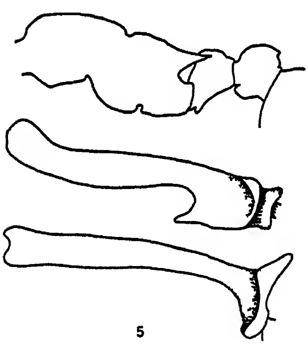

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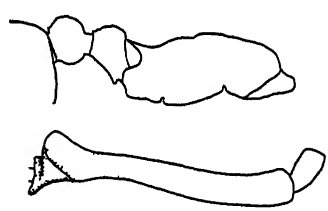

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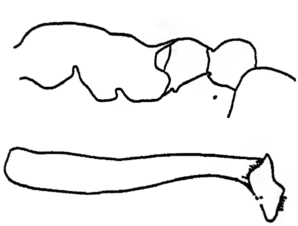

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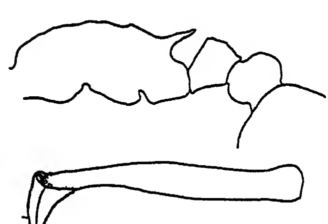

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Myrmica sulcinodis var. **sulcinodo-scabrinodis** Forel

M. sulcinodis var. *sulcinodo-scabrinodis* Forel, Fourmis Suisse, 1874: 77, ☿; Starcke, "De Levende Natuur," 1927: 13, ☿.

A name for the ants intermediate between *M. sulcinodis* and *M. scabrinodis*.

Myrmica sulcinodis subsp. **vicaria Kuznetzov-Ugamskij**

M. sulcinodis subsp. *vicaria* Kuznetzov-Ugamskij, "The Ants of the South Ussuri Region (in Russian)," 1928: 33, figs. 13, 14, ☿.

Worker (after Kuznetzov-Ugamskij): Length 3.7–4 mm.

Epinotal spines shorter than the basal surface of the epinotum; broad at the base, then strongly tapering to a pointed apex. Smaller than the typical form: length 4–4.5 mm. Declivous surface of the epinotum infraspinally smooth and strongly shining. Metasternal angles somewhat produced dorsally and pointed.

Type Locality: Ssutscham.

Myrmica myrmecophila Wasmann

M. myrmecophila Wasmann, Biol. Centralbl., 1910, *30:* 516, ♀; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 91.

Ergatoid Female (after Wasmann and Finzi): Length 5.2 mm.

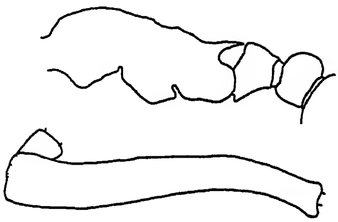
Head clearly smaller and lighter (than in *sulcinodis*), yellowish brown, a brownish cast only in middle of frons. Occiput bears medially an ocellus which is much smaller than in ♀ and ♂ *sulcinodis*. Frontal area more concave. Thorax as in ☿ *sulcinodis*, but gaster much larger (2.4 mm. long, 1.3 mm. broad). Epinotal spines longer than in *sulcinodis*, extending to middle of petiole, horizontal, parallel. Postpetiole, from above, twice as broad as the petiole. Circumference of gaster equal to that of a queen *sulcinodis*, in the same colony, which is almost 7 mm. long, while the head is only half the size. Sculpture of head and thorax corresponds to that of ♀ and ♂ *sulcinodis* but somewhat less coarse. Upright yellow hairs somewhat longer and thicker.

Tyrol: Arlberg Pass, 1,800 m., 27.VIII.91, from a flourishing *M. sulcinodis* colony (E. Wasmann).

Wasmann believed this peculiar ant may have been parasitic on the *sulcinodis*. Unfortunately, no other records are known.

EXPLANATION OF PLATE II

Fig. 1. Body outline and antennal scape of the worker of *Myrmica brevinodis* Emery. Fig. 2. Body outline and antennal scape of the worker of *Myrmica brevinodis* subsp. *sulcinodoides* Emery. Fig. 3. Body outline and antennal scape of the worker of *Myrmica brevinodis* subsp. *kuschei* Wheeler. Fig. 4. Body outline and antennal scape of the worker of *Myrmica brevinodis* subsp. *brevispinosa* Wheeler. Fig. 5. Body outline and antennal scape of the worker of *Myrmica brevinodis* subsp. *discontinua* Weber. Fig. 6. Body outline and antennal scape of the worker of *Myrmica wheeleri* Weber. Fig. 7. Body outline and antennal scape of the worker of *Myrmica punctiventris* Roger. Fig. 8. Body outline and antennal scape of the worker of *Myrmica punctiventris* subsp. *pinetorum* Wheeler.



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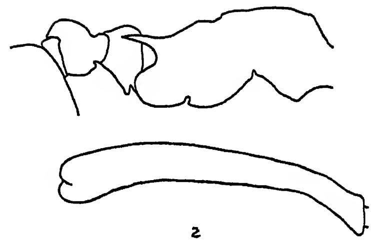

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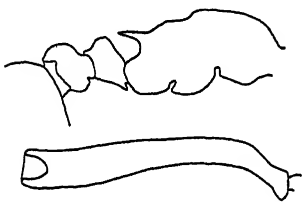

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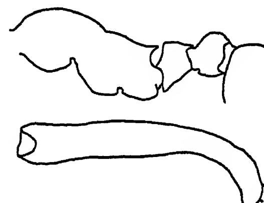

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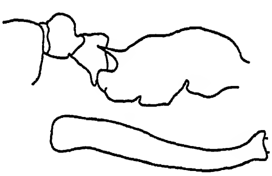

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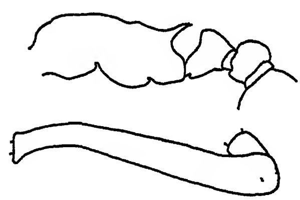

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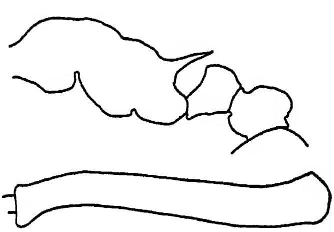

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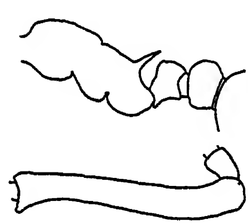

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Myrmica lobicornis Nylander

M. lobicornis Nylander, Act. Soc. Sc. Fennicae, 1846, *2:* 933–934, pl. 18, figs. 32, 33, ☿ ♀; Starcke, Ent. Bericht. Nederl. Ent. Vereen., 1926, *7:* 89–91; Starcke, "De Levende Natuur," 1927: 15; Starcke, Tijdschr. Ent., 1927, *70:* 73–84, 5 figs; Karawajew, Konowia, 1926, *5:* 283; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 106–107, fig. 13; Santschi, Rev. Suisse Zool., 1931, *38:* 347–348.

Worker (after Nylander): Length 1⅔–2 lin.

Similar to the preceding (*M. scabrinodis*) but less strongly robust, color and shape of the scape also distinct. Mandibles pale ferruginous, at the extreme apex fuscous. Frontal area conspicuous. Frontal lamina as in the preceding, margins dilated, a little reflexed. Antennae as dark as the mandibles, rufous; scape with compressed lobe which is a little concave, in the form of an almost semi-circular lamina, and situated in a transverse position above the bend near the base. This lobe is a little larger, more compressed, and not obliquely situated as in the preceding. Head laterally reticulate-rugose. Thorax and pedicel longitudinally, coarsely and roughly sculptured, sordid brownish ferruginous; nodes coarsely and irregularly rugose. Apex of gaster pale.

Female (after Nylander): Length 2½ lin.

Similar to the female of the preceding (*M. scabrinodis*), but colored otherwise and scape distinct.

Apex of the mandibles pale rufous. Frontal area, frontal laminae and antennal scapes as in the worker. Thorax fuscous, pronotum anteriorly with coarse, irregular rugosities, otherwise longitudinally and coarsely striate, base of the sculpturing and apically faintly brownish-rufous. Nodes fuscous, brownish-rufous between the coarse, sub-longitudinal rugosities. Wings as in the preceding, but tinted with still paler cinereous; 2⅓ lin. long. Legs shining, pale ferruginous, with long yellowish pubescence. Apex of gaster pale fusco-rufescent.

Male (after Emery):

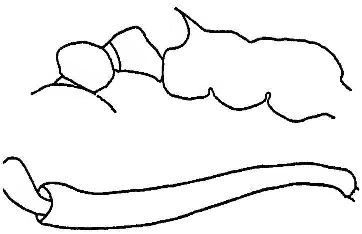
Very distinguishable in the formation of the antennae: the funiculus is short, the scape about half as long as the funiculus (equal in length to the following six segments together) and, at the basal third, angularly bent.

Distribution: North Europe to Central Asia; Alps, Apennines.

Figure 32a of Nylander's description is of an antennal scape in posterior view; the scape is bent obtusely and the lamina appears as a high, but rounded, tubercle in profile. Figure 32b shows the lamina from above; it appears transversely elliptical with the basal margin

EXPLANATION OF PLATE III

Fig. 1. Body outline and antennal scape of the worker of *Myrmica rubra* (L.). Fig. 2. Body outline and antennal scape of the worker of *Myrmica rubra* var. *silvestrii* Wheeler. Fig. 3. Body outline and antennal scape of the worker of *Myrmica rubra* subsp. *yoshiokai* Weber. Fig. 4. Body outline and antennal scape of the worker of *Myrmica laevinodis* Nylander. Fig. 5. Body outline and antennal scape of the worker of *Myrmica smythiesi* Forel, cotype. Fig. 6. Body outline and antennal scape of the worker of *Myrmica smythiesi* subsp. *dshungarica* Ruzsky. Fig. 7. Body outline and antennal scape of the worker of *Myrmica smythiesi* subsp. *himalayana* Weber. Fig. 8. Body outline and antennal scape of the worker of *Myrmica smythiesi* subsp. *hecate* Weber.



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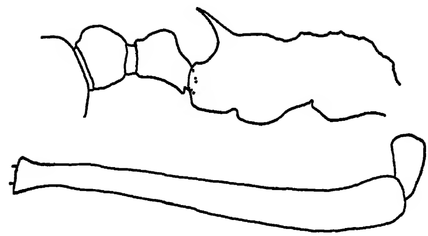

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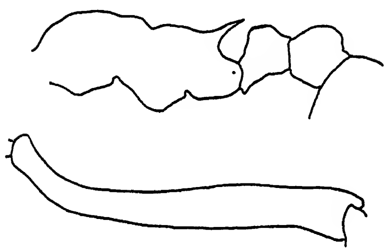

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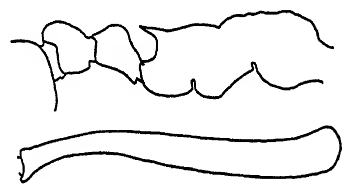

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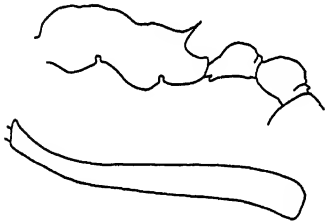

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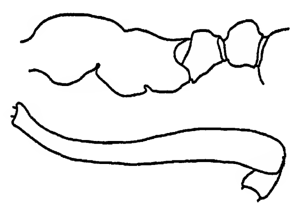

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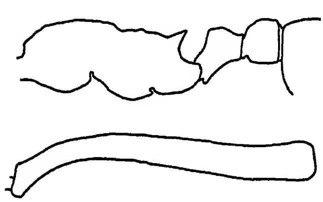

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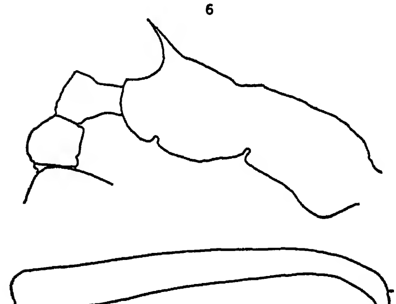

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straight. Figure 33 shows the frontal area as an isoceles triangle with concave basal margin.

The *lobicornis* male genitalia are similar to those of *scabrinodis*, *sabuleti*, *schenck:* and *brevinodis*. For this reason and because of frequent intermediate conditions in the worker castes they may perhaps be considered closely related species capable of hybridizing.

Myrmica lobicornis subsp. **alpestris** Arnoldi

M. lobicornis subsp. *alpestris*, Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 168, ☿ ♂.

A form from the U. S. S. R. unknown to me.

Myrmica lobicornis subsp. **alpina** Stärcke

M. lobicornis subsp. *alpina* Stärcke, Tijdschr. Ent., 1927, *70:* 80–81, fig. 2, ☿ ♀.

Val Aosta.

For a description of this form see the reference above.

Myrmica lobicornis subsp. **angustifrons** Stärcke

M. lobicornis subsp. *angustifrons* Starcke, Tijdschr. Ent., 1927, *70:* 81–82, fig. 3, ☿ ♀.

England: Surrey: Weybridge (H. Donisthorpe).

For a description of this form see the reference above.

Myrmica lobicornis subsp. **apennina** Stärcke

M. lobicornis subsp. *apennia* Starcke, Tijdschr. Ent., 1927, *70:* 82–83, ☿.

Appennines: Monte Cimone (C. Menozzi).

For a description of this form see the reference above.

Myrmica lobicornis subsp. **arduennae** Bondroit

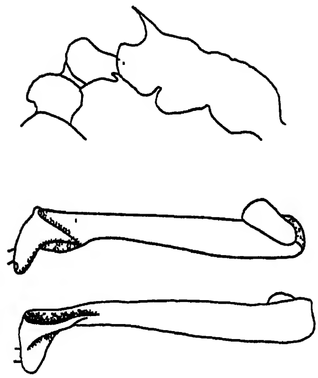
M. lobicornis var. *arduennae* Bondroit, Ann. Soc. Ent. Belg., 1911, *55:* 12, ☿ ♀ ♂.
M. lobicornis st. *arduennae* (Bondroit), Santschi, Rev. Suisse Zool., 1931, *38:* 349–350, fig. 4.

Belgium: Hockay.

For descriptions of this form see the references above.

EXPLANATION OF PLATE IV

Fig. 1. Body outline and antennal scape of the worker of *Myrmica scabrinodis* Nylander of Europe. Fig. 2. Body outline and antennal scape of the worker of *Myrmica moravica* Soudek. Fig. 3. Body outline and antennal scape of the worker of *Myrmica lobicornis* Nylander of Europe. Fig. 4. Body outline and antennal scape of the worker of *Myrmica ritae* subsp. *serica* Wheeler. Fig. 5. Body outline and antennal scape of the worker of *Myrmica sabuleti* Meinert of Europe. Fig. 6. Body outline and antennal scape of the worker of *Myrmica ritae* subsp. *formosae* Wheeler. Fig. 7. Body outline and antennal scape of the worker of *Myrmica schencki* Emery of Europe. Fig. 8. Body outline and antennal scape of the worker of *Myrmica ritae* subsp. *indica*, n. subsp.



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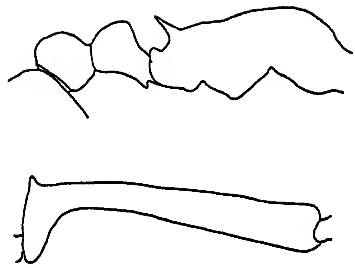

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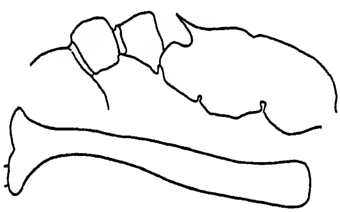

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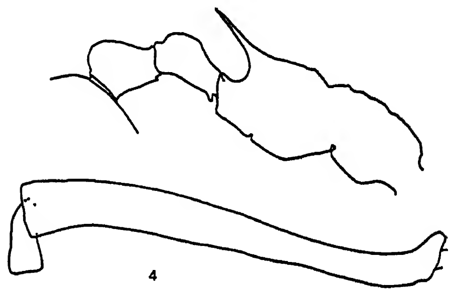

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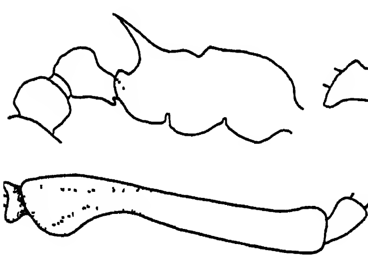

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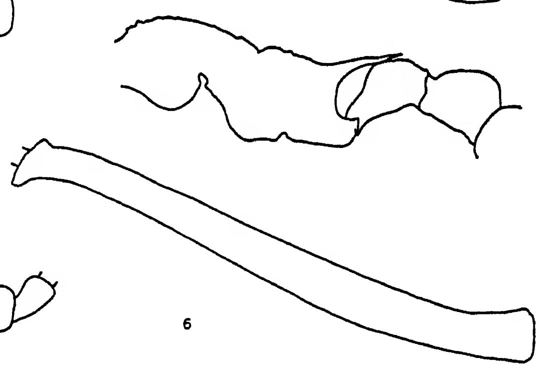

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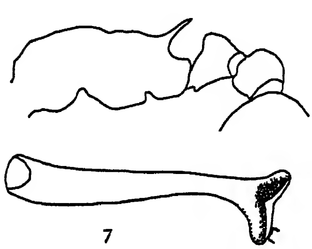

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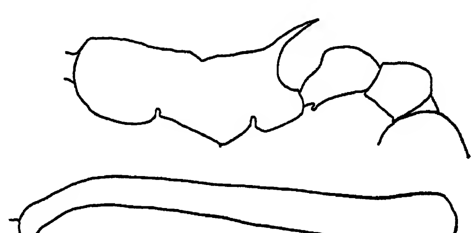

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Myrmica lobicornis subsp. **deplanata** Ruzsky

M. scabrinodis lobicornis var. *deplanata* Ruzsky, Formic. Imp. Rossici, 1905: 700, ☿.

Worker (after Ruzsky):

Differing from the typical *lobicornis* in the near absence of a meso-epinotal impression so that the thorax, in profile, is evenly convex. Epinotal spines shorter, thin, acute. Bend of the antennal scape with a sharper tooth or small, sharp lobe. Postpetiole dorsally nearly smooth, weakly shining and with finer, thinner reticulations. Pilosity sparse, almost entirely absent on the thorax and dorsal surface of the gaster.

Type Localities: Caucasus, Krim, Gouv. Saraton on the steppe; steppe near Orenburg.

Myrmica lobicornis subsp. **foreli** Santschi

M. lobicornis st. *foreli* Santschi, Rev. Suisse Zool., 1931, *38:* 348–349, ☿ ♀.

Type Locality: Tyrol: Schluderbach (Forel). For a description of this form from the Forel collection see the reference above.

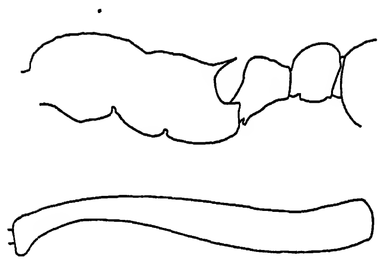
Myrmica lobicornis subsp. **fracticornis** Emery

M. scabrinodis scabrinodis var. *fracticornis* Emery, Zool. Jahrb. Abth. f. System., 1894, *8:* 313, ☿.
M. rubra scabrinodis var. *fracticornis* Wheeler, "Ants," 1910: 566, ☿.
M. scabrinodis scabrinodis detrinodis Emery, Zool. Jahrb. Abth. f. Syst., 1894, *8:* 316, ☿.
M. rubra scabrinodis var. *detritinodis* Wheeler, "Ants," 1910, 566, ☿.
M. sabuleti var. *lobifrons* (In Part), Pergande, Proc. Washington Acad. Sc., 1900, *2:* 521, ☿.
M. rubra scabrinodis var. *lobifrons* (In Part) Wheeler, "Ants," 1910: 566, ☿.
M. scabrinodis lobicornis var. *lobifrons* (In Part) Wheeler, Bull. Mus. Comp. Zool., 1917, *61:* 17, 21, ☿.
M. rubra scabrinodis var. *glacialis* Forel, Ann. Soc. Ent. Belg., 1904, *48:* 154; Wheeler, "Ants," 1910: 566, ☿.
M. scabrinodis lobicornis var. *glacialis* Wheeler, Proc. Amer. Acad. Arts Sc., 1917, *52:* 504, ☿; Wheeler, Bull. Mus. Comp. Zool., 1917, *61:* 21, ☿.

The following descriptions are of a worker cotype from New Haven, Connecticut, and of all castes of a single colony from the Santa Catalina Mountains, Arizona.

EXPLANATION OF PLATE V

Fig. 1. Body outline and antennal scape of the worker of *Myrmica rugosa* Mayr. Fig. 2. Body outline and antennal scape of the worker of *Myrmica rugosa* subsp. *arisana* Wheeler. Fig. 3. Body outline and antennal scape of the worker of *Myrmica pachei* Forel, cotype. Fig. 4. Body outline and antennal scape of the worker of *Myrmica kurokii* Forel. Fig. 5. Body outline and antennal scape of the worker of *Myrmica bergi* Ruzsky, cotype. Fig. 6. Body outline and antennal scape of the worker of *Myrmica sulcinodis* Nylander. Fig. 7. Body outline of an anomalous worker of *Myrmica brevinodis* subsp. *brevispinosa* Wheeler from Montana. The petiole is fused with the epinotum, which lacks the customary spines, and the postpetiole appears to be absent. Fig. 8. Dorsal view of the abdomen of an anomalous alate female of *Myrmica brevinodis* Emery from North Dakota. The red petiole is normal; the red post-petiole, however, is asymmetrically fused with the anterior portion of the brown first gastric segment and its amorphous remains extend out between the first and second gastric segments.



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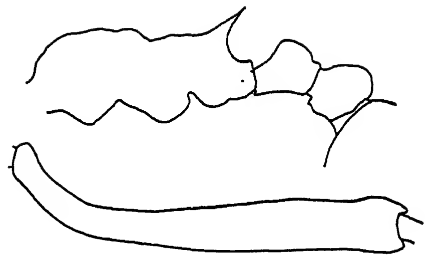

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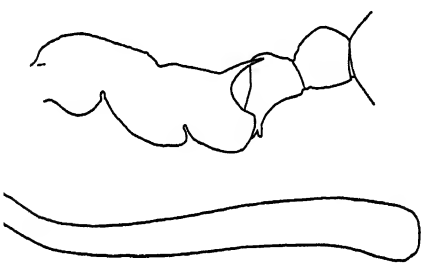

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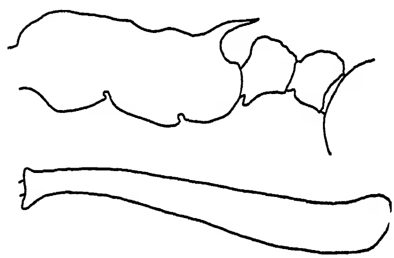

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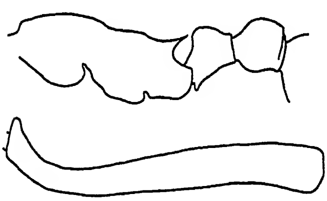

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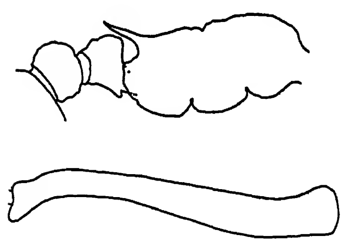

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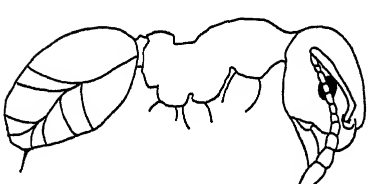

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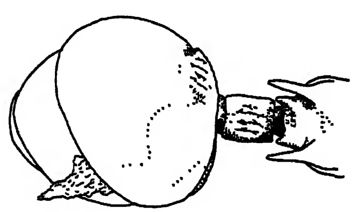

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Worker (Cotype): Length 4.9 mm.

Antennal scapes exceeding posterior margin of head by a distance less than the distal diameter of the scape; seen from above, in the form of a drawn-out sigmoid curve, at the base laterally compressed, with a rounded, more or less upright, lamina which extends completely around the base in a transverse position, and extends along both sides of the scape to a distance about equal to the width of the transverse section; seen from behind, the scape is sharply bent at the base in an obtuse angle, the lamina appearing as a slight tooth; distal diameter nearly twice that of the proximal portion; antennal club indistinctly 4-jointed, funicular joints 1 and 2 together equal in length to joints 3–5 together. Thorax, in profile, evenly convex to the deep and distinct mesoepinotal suture; epinotal spines moderate in length, directed upwards at an angle of about 30 degrees and backwards, straight and acute, shorter than the epinotal declivity ventral to them; from above, moderately diverging, slightly longer than the distance between their bases. Petiole in profile slightly longer from apex of ventral tooth to postpetiole than it is high, with anterior face a little concave, rounded antero-dorsal and postero-dorsal angles and nearly flat top. Postpetiole in profile about 0.7 as long as high, with anteriorly produced ventral lobe; from above subglobular. Gaster long-ovate. Legs moderate in length.

Surface of head moderately sculptured, median dorsal area longitudinally rugose, sides and posterior surface irregularly reticulate-rugose, whole surface thickly and conspicuously punctate at the base of the sculpturing; frontal area clearly delimited, punctate, striated at the margins. Surface of the thorax deeply vermiculate-rugose, more regularly rugose posteriorly and less deeply sculptured on the sides. Surfaces of the petiole irregularly vermiculate, distinctly punctate. Dorsal surface of the postpetiole longitudinally and concentrically rugose-punctate, a median dorsal area somewhat smoother, lateral surfaces rugose. Gaster smooth and shining.

Pilosity moderate, hairs of medium length, suberect, acute, except on the dorsal surface of the thorax, where truncate.

Color ferruginous, dorsal surface of the head and posterior surface of the 1st gasteric segment more brownish.

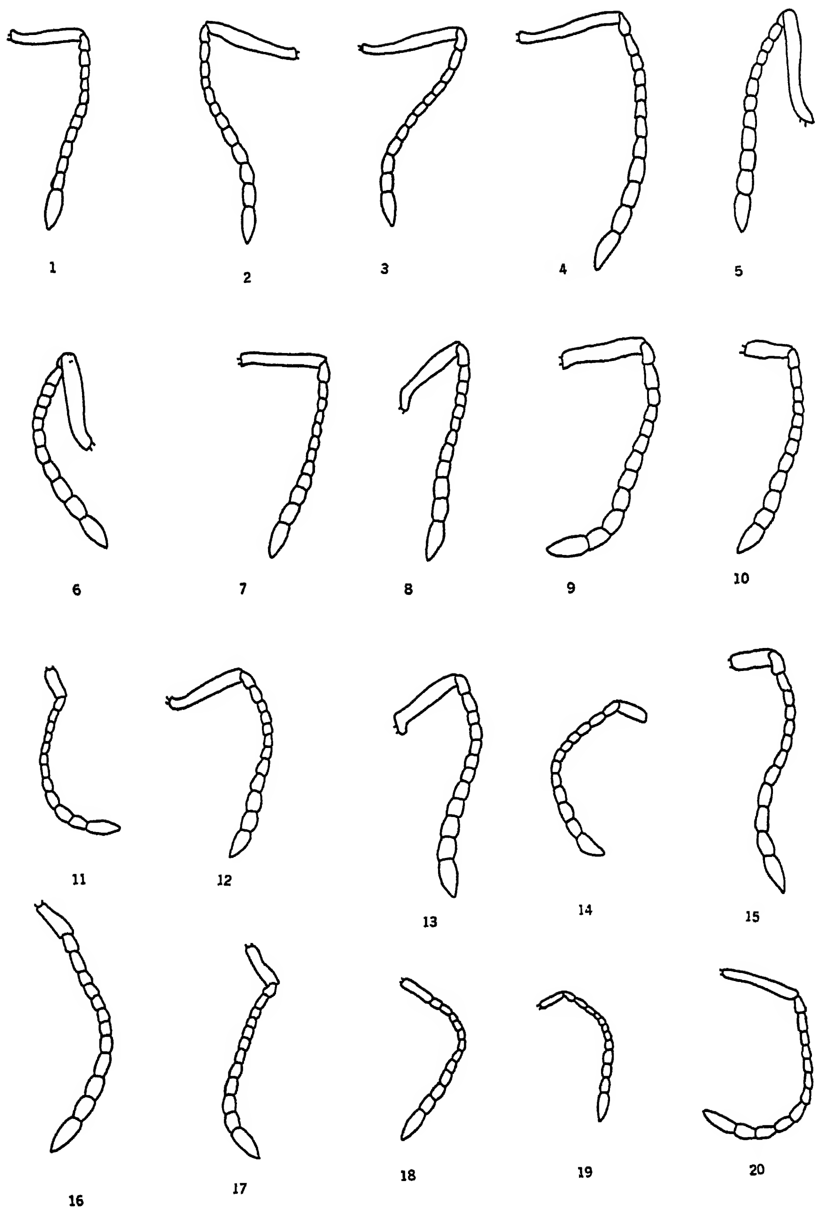
Worker (Arizona specimens): Length 3.9–6 mm.

EXPLANATION OF PLATE VI

Antennae of males of species of *Myrmica:*

Fig. 1. *Myrmica laevinodis* Nylander. Fig. 2. *Myrmica laevinodis* var. *bruesi* Wheeler. Fig. 3. *Myrmica smythiesi* subsp. *dshungarica* Ruzsky. Fig. 4. *Myrmica sulcinodis* Nylander. Fig. 5. *Myrmica sulcinodis* var. *sulcinodoscabrinodis* Forel. Fig. 6. *Myrmica scabrinodis* subsp. *mexicana* Wheeler. Fig. 7. *Myrmica lobicornis* Nylander. Fig. 8. *Myrmica lobicornis* subsp. *fracticornis* Emery. Fig. 9. *Myrmica sabuleti* subsp. *americana* Weber. Fig. 10. *Myrmica sabuleti* subsp. *hamulata* Weber. Fig. 11. *Myrmica sabuleti* subsp. *nearctica* Weber. Fig. 12. *Myrmica schencki* Emery. Fig. 13. *Myrmica schencki* subsp. *emeryana* Forel. Fig. 14. *Myrmica schencki* subsp. *tahoensis* Wheeler. Fig. 15. *Myrmica brevinodis* Emery. Fig. 16. *Myrmica brevinodis* subsp. *sulcinodoides* Emery. Fig. 17. *Myrmica brevinodis* subsp. *brevispinosa* Wheeler. Fig. 18. *Myrmica wheeleri* Weber. Fig. 19. *Myrmica punctiventris* subsp. *pinetorum* Wheeler. Fig. 20. *Myrmica punctiventris* Roger.

PLATE VI



General characters of the cotype with the following variations: The lateral extensions of the lamina at the bend of the antennal scape may be practically absent; seen from above the epinotal spines may be distinctly shorter than the distance between their bases and may be blunt and subparallel; the anterior face of the petiole may be plane; the postpetiole may be twice as high as long with the anteriorly produced ventral lobe acutely angular.

The frontal area may be entirely striate, though clearly delimited; the sculpturing of the anterior part of the thorax may be deeply and irregularly reticulate; the sculpturing of the pedicel may be much feebler though conspicuously punctate and the rugosity of the postpetiole not distinctly concentric.

The pilosity may be comparatively abundant.

The color of the body ranges from ferruginous to a dark brown, almost black, with the appendages somewhat lighter but still quite dark brown.

Female: Length 4.7–6.4 mm.

Similar to the worker, with the usual sexual differences, including the following:

Epinotal spines distinctly shorter than the part of the epinotal declivity ventral to them, with blunt tips, and, from above, diverging.

Sculpture of the pronotum coarsely reticulate anteriorly, becoming rugose posteriorly and on the remainder of the sides; scutum of mesonotum anteriorly with a small smooth median area from which radiate scattered rounded vermiculations, postero-medially becoming more or less parallel rugosities; base of the sculpturing of the body, exclusive of the gaster, thickly punctate.

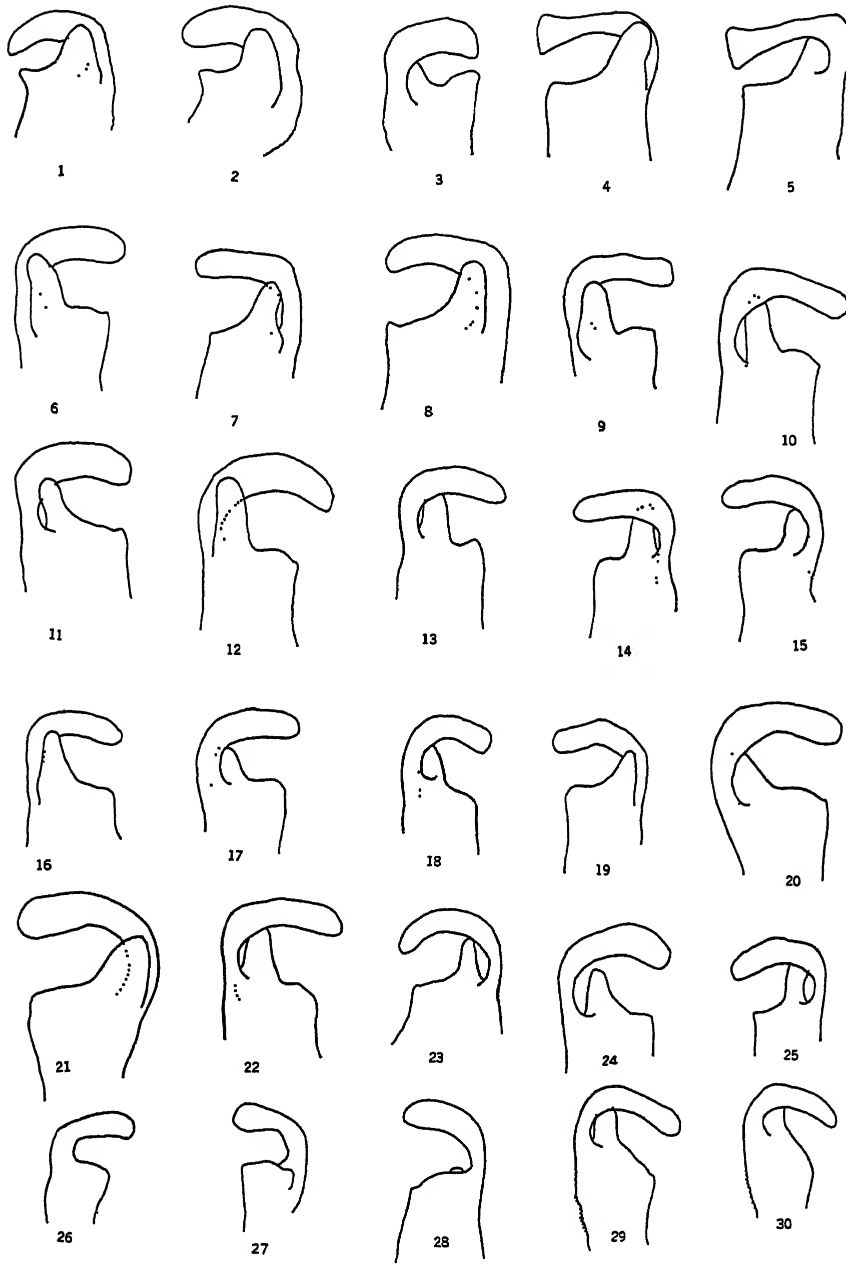
Color of body dark brown, appendages somewhat lighter. Wings hyaline, with a brownish cast; veins brown.

Male: Length 4.5–6.6 mm.

EXPLANATION OF PLATE VII

Volsellae of male genitalia of *Myrmica* species:

Fig. 1. *Myrmica laevinodis* Nylander. Fig. 2. *Myrmica laevinodis* var. *bruesi* Wheeler. Fig. 3. *Myrmica smythiesi* subsp. *dshungerica* Ruzsky. Fig. 4. *Myrmica sulcinodis* Nylander. Fig. 5. *Myrmica sulcinodis* var. *sulcinodo-scabrinodis* Forel. Fig. 6. *Myrmica scabrinodis* Nylander. Fig. 7. *Myrmica scabrinodis* subsp. *mexicana* Wheeler. Fig. 8. *Myrmica lobicornis* Nylander. Fig. 9. *Myrmica lobicornis* subsp. *fracticornis* Emery. Fig. 10. *Myrmica lobicornis* subsp. *fracticornis* Emery. Fig. 11. *Myrmica sabuleti* Meinert. Fig. 12. *Myrmica sabuleti* subsp. *americana* Weber. Fig. 13. *Myrmica sabuleti* subsp. *hamulata* Weber. Fig. 14. *Myrmica sabuleti* subsp. *hamulata* Weber. Fig. 15. *Myrmica sabuleti* subsp. *nearctica* Weber. Fig. 16. *Myrmica schencki* Emery. Fig. 17. *Myrmica schencki* subsp. *emeryana* Forel. Fig. 18. *Myrmica schencki* subsp. *emeryana* Forel. Fig. 19. *Myrmica schencki* subsp. *tahoensis* Wheeler. Fig. 20. *Myrmica brevinodis* Emery. Fig. 21. *Myrmica brevinodis* Emery subsp. *sulcinodoides* Emery. Fig. 22. *Myrmica brevinodis* subsp. *brevispinosa* Wheeler. Fig. 23. *Myrmica scabrinodis* subsp. *wesmaeli* Bondroit. Fig. 24. *Myrmica scabrinodis* (= *M. specoides* Bondroit). Fig. 25. *Myrmica scabrinodis* subsp. *rugulosoides* var. *striata* Finzi. Fig. 26. *Myrmica wheeleri* Weber. Fig. 27. *Myrmica wheeleri* Weber. Fig. 28. *Myrmica moravica* Soudek. Fig. 29. *Myrmica punctiventris* Roger. Fig. 30. *Myrmica punctiventris* subsp. *pinetorum* Wheeler.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Antennal club indistinctly 4-jointed; antennal scape equal in length to from 5–6 of the following funicular joints together; seen from a postero-dorsal view bent obtusely at the basal ⅓, 0.6 as wide at the somewhat compressed base as at the distal part; joints 1–2 of the funiculus together distinctly longer than joints 3–5 together. Epinotal declivity dorsally with two obtuse tubercles. Petiole in profile distinctly higher than the exposed ventral surface is long, with plane anterior face and evenly convex postero-dorsal surfaces. Postpetiole, in profile, 0.6 as long as high, elliptical. Gaster ovate, 19–30 teeth on the sagittae, averaging 24, volsellae of genitalia as illustrated. Legs moderately long and slender.

Surface of head shining, with sparse, irregular, somewhat fine rugae or vermiculations, densely punctate at the base of the sculpturing; thorax largely smooth and shining, striate at the margins of the segments and sparsely punctate laterally; petiole shining, finely punctate and with scattered striae; postpetiole and gaster smooth and shining.

Hairs of head short, fine, subappressed and numerous; of thorax short, fine and sparse; of pedicel and gaster fine and moderately abundant; of appendages numerous, fine and unappressed. Appressed pubescence on the legs.

Color of head black; of remainder of body and appendages blackish brown; apex of gaster, antennal club and tarsal joints brown. Wings hyaline with a brownish cast; veins brown.

There is an amazing range of variation in this subspecies over North America, but with completely intermediate conditions. This variation can not be decisively correlated with ecological conditions because of the absence of other than date and locality records for many of the specimens. In general, the darkest ants come from the mountains of the West and from eastern Canada.

Type Localities: Connecticut (Pergande); New York: Buffalo (Wasmann); "Dakota."

Other Localities:

NEWFOUNDLAND: Bay of Islands (Gratacap). NOVA SCOTIA: Pleasantfield (W. H. Prest); Penobsquis, Portaupique (C. A. Frost); Port Maitland (W. Reiff); Truro (no collector); Digby (J. Russell); Yarmouth (T. D. A. Cockerell). NEW BRUNSWICK: St. Andrews (R. O. M. Z.). QUEBEC: Chelsea, Hull, Kingsmere (W. M. Wheeler). ONTARIO: East Main R., border of Ungava, James Bay (A. Skinner); Gravenhurst, Muskoka Dist., Ottawa (no collectors); Pelee Isl. (M. Talbot); Franz (N. A. Weber); Lake Couchiching, Arnprior, Lampton, Toronto, Weston (R. O. M. Z.); Manitoulin I. (C. H. Kennedy). MAINE: Kittery Point (Pergande Coll.); Old Town, Presque Isle (M. W. Wing); Ocean Point (E. & G. Wheeler); Glenmere (W. M. Wheeler); Gardiner, Salsbury Cove, Mt. Desert I. (N. A. Weber). NEW HAMPSHIRE: Errol and Swift Diamond Farm, Coos Co. (H. Shapley); Franconia (Fiske); Mt. Washington Summit (C. S. Bacon, A. T. Slosson); Contoocook (E. & G. Wheeler). VERMONT: Woodstock (N. A. Weber). MASSACHUSETTS: Woods Hole (H. Bagg, T. D. A. Cockerell, W. M. Wheeler); New Boston, Berkshire Co. (W. M. Wheeler); Milton (C. H. Blake); Truro (A. P. Morse); Middlesex Falls, Stony Brook Res., Boston, S. Wellfleet

(N. A. Weber). CONNECTICUT: Colebrook, Litchfield Hills (W. M. Wheeler); New Haven (Type Locality, T. Pergande); East Wallingford (R. F. Snodgrass). NEW YORK: Pine Island, Niagara Falls, Ithaca (no collectors); Greenville, Mosholu, Branxville (W. M. Wheeler); Fishers Isl., Flatbush, L. I. (T. Pergande); Suffern (A. T. Gaul). NEW JERSEY: So. Orange, Fort Lee, Hoboken, Arlington (no collectors); Matawan (W. M. Miller); "New Jersey" (T. Pergande). PENNSYLVANIA: St. Vincent (Schmitt); Centre Co., Spring Creek, State Coll., Penn-Roosevelt Dam, Philadelphia (W. L. Brown). DISTRICT OF COLUMBIA: Washington (T. Pergande). MARYLAND: Bladensburg (T. Pergande). WEST VIRGINIA: Terra Alta, Preston Co. (G. C. Wheeler). TENNESSEE: Smoky Mts., (A. C. Cole); Chimney Peaks, Montvale Spgs. (C. H. Kennedy). SOUTH CAROLINA: Caesar's Head (M. R. Smith). OHIO: Columbus (M. R. Smith); North Bass and Sisters Isl. (M. Talbot); Put-in-Bay, Green Isl. (C. H. Kennedy); Southcentral Reg. (L. G. & R. G. Wesson); Killdeer Plain (M. E. Amstutz). INDIANA: Plymouth (M. R. Smith); Dune Acres (D. Lowrie); Lafayette (H. O. Deay). ILLINOIS: Rockford (W. M. Wheeler); Cook Co., Chicago (H. Brun); Momence (D. Lowrie). MICHIGAN: Warrens Dunes (M. Talbot); Ann Arbor (J. Dawson); Porcupine Mts. (O. M. McCreary). WISCONSIN: Madison (A. C. Burrill); Lake Geneva, Williams Bay (Ill. Nat. Hist. Surv.); Milwaukee (Cudahy); Calhoun (no collectors). IOWA: Ames (T. Pergande); Siuox City (C. N. Ainseli).

MINNESOTA: Brainerd, Bemidji (N. A. Weber); Duluth (R. E. Gregg). NORTH DAKOTA: Mikkelson (J. E. Goldsberry); Towner, Grassy Butte, Cannonball R., Dunseith, Anamoose, Upham, Langdon, Edmore, Stanley, Hope, Bismarck (N. A. Weber); Wildrose (no collector); Dickinson (C. N. Ainslie); Cass Co., Fabian, Fargo, Gardner (C. Schonberger); Divide Co. (J. Davis); Hettinger Co., Garrison (R. P. Uhlmann). SOUTH DAKOTA: Hill City (W. S. Creighton, Pergande Coll.); Spearfish, Kennebec (A. C. Cole.) NEBRASKA: North Platte (A. C. Cole). KANSAS: Richmond (E. G. Titus). MANITOBA: Turtle Mts., Audy L., Riding Mt. Nat. Park (N. A. Weber). SASKATCHEWAN: Saskatoon (K. M. King); Gainsborough (N. A. Weber). ALBERTA: Bilby, Edmonton (G. Salt); Banff (P. Darlington, G. Salt, W. M. Wheeler); Moraine Lake, Lake Louise (W. M. Wheeler); Vermillion Pass (E. Whymper). MONTANA: Browning (W. S. Creighton). WYOMING: Yellowstone Park (A. C. Cole); U. of Wyo. Camp., 9,600 feet (T. D. A. Cockerell). IDAHO: Twin Falls, Stanley (A. C. Cole); Double Springs, Lost River Range, Gibbons Pass, Bitteroot Mts., (W. S. Creighton). COLORADO: Florissant, Colorado Springs, Cripple Creek, 10,200 ft., Buena Vista, Cheyenne Canyon, Manitou (W. M. Wheeler); Ute Pass (T. D. A. Cockerell, W. M. Wheeler); Sugar Loaf Mt., Eldora, 8,600 ft., Pikes Peak (T. D. A. Cockerell); Creede Co., 8,844 feet (S. J. Hunter); Rocky Mts., Nat. Park, 9,000 and 9,500 feet (N. A. Weber); Boulder (W. S. Creighton, P. J. Schmitt); Hartsel, Fraser, Winfield, Gransby (W. S. Creighton). UTAH: Salt Lake Co. (R. V. Chamberlin, Grundmann, Fox); Blue Mts., Mirror L., Uinta Mts., 10,000 feet, La Sal Mts., Bryce Canyon (W. S. Creighton); Alta, Camas, Wales Summit Co.) (Grundmann, Rees); Neole, Duchesne Co. (Knowlton & Harmston). NEVADA: Contact (A. C. Cole). MEW MEXICO: Beulah,

8,000 feet (T. D. A. Cockerell); James Canyon, 8,000 feet; Cox Canyon, 9,300 feet; Cloudcroft, 8–9,000 feet; Sacramento Mts., (W. M. Wheeler); Harvey's Ranch, Las Vegas Mts., 10,000 feet (E. L. Hewett); Taos (A. C. Cole). ARIZONA: Coconino Forest, Grand Canyon, Mt. Lemmon, 8–9,100 feet, Stratton, 6–7,000 feet and Bear Wallow, 8,000 feet, Santa Catalina Mts., (W. M. Wheeler); Ramsey Canyon, Huachuca Mts., 9,000 feet (W. M. Mann); Jacob's Lake, Kaibab Forest, 9,000 feet (W. S. Creighton, N. A. Weber). ALASKA: Metlahtla (T. Kincaid). BRITISH COLUMBIA: Emerald Lake (W. M. Wheeler); Carbonate and Prairie Hills, Selkirk Mts. (J. C. Bradley). OREGON: Neskowen, Mt. Hood, 6,000 feet (A. C. Cole).

The winged castes appear frequently in huge, dense swarms from late June to October. The following records are in the collection: Ontario: Aug. 9–Oct.; Quebec: Aug. 31; New Hampshire: Aug.; Massachusetts: Sept. 4; Connecticut: July 21–Aug. 29; New York: Aug. 2–Sept. 8; New Jersey: Sept. 22; Pennsylvania: Oct. 10; District of Columbia: Sept. 18–Oct. 12; Virginia: Aug. 27; Ohio: Oct. 8; Illinois: July 13–Oct. 24; Iowa: Aug.; South Dakota: July–Sept. 23; North Dakota: Aug. 19–Oct. 5; Colorado: June 26–Aug. 18; Arizona: July 24; New Mexico: July 8–14; Arizona: July 12–27; Saskatchewan: July 15; Alberta: Aug. 19; Idaho: July 3–Aug. 25; Nevada: Aug. 18; Utah: Aug. 10–14; Oregon: July 12; British Columbia: Aug. 13.

The variety *lobifrons*, which was described by Pergande in 1900 as a variety of *sabuleti*, has been synonymized after the direct comparison of the paratype referred to by Dr. Wheeler (1917 b, p. 21) with the cotype of *fracticornis*. The original description is too incomplete to be of value. The paratype is darker than the cotype of *fracticornis*, which is considered typical, but not darker than another cotype. The antennal scape has the same transverse lamina at the joint, though somewhat smaller; the epinotal spines are similar. The sculpturing is the same.

The variety *glacialis*, which was described by Forel in 1904 as a variety of *scabrinodis*, has been synonymized after the direct comparison of a cotype with the cotype of *fracticornis*. This is also darker in color but otherwise practically indistinguishable, with the same type of antennal scape, epinotal spines, sculpturing and other characters. In his original description Forel admitted its resemblance to *fracticornis* but separated it because "tous les articles du funicule sont au moins aussi longs qu'epais." I find, however, that in the cotype the joints are longer than broad, although the 3rd to 6th are quite broad, as also in *fracticornis*.

This cotype of *fracticornis* is probably one of the specimens responsible for Emery's original description of the variety as "klein, dunkel gefarbt, Fuhlerschaft gekinckt, an der Basis wenig compress, ohne oder mit einem kleinen, spitzen zahn."

The study of two cotypes of *detritinodis* and the comparison of them with cotypes of *fracticornis* and *emeryana* convinces me that they would be better considered as specimens transitional between the above mentioned forms. The antennal scape is very similar to the scape of *emeryana* in the possession of a high oblique keel along the anterior and medial side of the bend and its practical absence on the posterior side. The sculpturing, however, is that of *fracticornis*; the rugae of the medial

dorsal surface of the head are much more regular than that of *emeryana*; the dorsal longitudinal smooth area of the postpetiole is similar to that in some *fracticornis* workers and quite different from the deeply rugose surface im *emeryana*. While there are other workers resembling the cotypes of *detritinodis* to be found in colonies of the other forms it does not seem desirable to retain a separate name for these. They are, after all, only transitional between forms in a highly variable genus.

The following variations may be noted in the castes of this form:

Males with the antennal scape equal in length to the 7 following joints together.

A few dark brown workers from Terra Alta, West Virginia, have somewhat shorter antennal scapes and with the dorsal keel at the bend greatly reduced; the epinotal spines are acute and strongly diverging. The rugosity of the head is unusually regular; the sculpturing of the thorax and pedicel is remarkably open, being, on the anterior part of the thorax especially, irregularly reticulate and on the pedicel nearly absent; the base of the thoracic sculpturing is punctate, that of the pedicel faintly reticulate. The discovery of the winged castes may necessitate establishing these as a distinct form but I hesitate to describe new forms upon such limited material in this highly variable genus.

Transitions to M. sabuleti subsp. americana

Workers with a wide lamina along the posterior margin of the antennal scape approaching the condition in *sabuleti* are found, but uncommonly. Among winged specimens, apparently from the same swarm, from Ontario are females of this *sabuleti* type with typical *fracticornis* females and males.

Transitions to M. brevinodis subsp. brevispinosa

The antennal scape of workers and females, which have no keel on the dorsal part and only a slight indication of a keel on the compressed basal portion closely resemble the scapes of *brevispinosa*. The epinotal spines, however, are of normal length. The most distinct of this form include a dark worker cotype of *fracticornis* from New Haven, Connecticut, three workers from Yellowstone Park, Wyoming, and three workers with a small *fracticornis* male from Mikkelson, North Dakota. It does not seem desirable to consider them a distinct form.

Anomalies

An abnormal male with fused antennal joints from Cheyenne Creek, near Colorado City, Colorado, was found with normal males; on the one antenna the distal two joints were fused, on the other the distal three joints were more or less completely fused. In a collection from Kennebec, South Dakota, occur males with distinct and acute epinotal spines and males with normal, obtuse tubercles. A worker from Calhoun, Wisconsin, has asymmetrical epinotal spines, the right spine being a little shorter than normal, the left spine being hardly longer than its base is wide.

BIOLOGY

This form frequently nests under stones or wood, occasionally under grass, especially in fairly damp situations. In the mountains of the West, according to Dr. Wheeler, it nests in rocky, warm slopes on openings among the pines. In North Dakota it is found in moister and more shaded localities than is *sabuleti americana.* The brood is kept in a series of chambers scattered through the top few inches of the soil, sometimes deeper. The workers of this subspecies are timid, some becoming temporarily immobile when disturbed. In digging up a colony at Towner, North Dakota, a new species of "velvet ant" or wasp of the family Myrmosidae, which I have described as *Myrmosa dakotensis* (Weber, 1934), was obtained which may have been parasitic on the ants. A colony from the same locality was taken to the island of Cuba and flourished in an observation nest in the much hotter and more humid climate until ended over a month later. The workers reared winged females from pupae of this colony on July 7, several weeks earlier than they have been taken in North Dakota.

In the Turtle Mountains of this state, several miles from the Canadian boundary, I found a colony of *fracticornis* nesting in close proximity to one of *Leptothorax acervorum canadensis* Prov.[1] The brood of the *Leptothorax* was in a curled-up leaf under debris on top of the soil and in several shallow chambers in the soil while the *Myrmica* brood was found in slightly deeper chambers a few centimeters away. The tangle of roots and the lateness of the day prevented careful examination of the nests but some tunnels of the two species were evidently very close to each other. The ants were removed and put in an observation nest where the two species took possession of separate cells though neither was aggressively hostile to the other. The *Leptothorax*, however, died within a few days. It is possible that the relations of the two species may be similar to those found by Dr. Wheeler between *M. brevinodis* and *L. emersoni* (Wheeler, 1903, 1907).

Myrmica lobicornis subsp. **jessensis** Forel

M. lobicornis var. *jessensis* Forel, Ann. Soc. Ent. Belg., 1901, *45:* 371, ☿.

Worker (after Forel):

Lobe of the antennae a little shorter than in the type, epinotal spines shorter and the petiolar node more rounded. Somewhat near the var. *schencki* Emery. Color deep as in *lobicornis* of the Alps and the North. Lobe of the antennae much more developed than in *fracticornis* Em. of the U. S.

Myrmica lobicornis var. **kieviensis** Karawajew

M. lobicornis var. *kieviensis*, Karawajew, Travaux syst. et faun., Ukrainian Acad. Sci., Kiev., 1934, p. 91, ☿.

A form from Kiev, Ukraine unknown to me.

Type Locality: Japan: Sapporo (Jesso Island).

[1]Near these was a nest of *Dolichoderus* (*Hypoclinea*) *plagiatus* subsp. *pustulatus* Mayr (det. Dr. W. M. Wheeler, *in litteris*), northernmost record of this genus in North America.

Myrmica lobicornis subsp. **lissahorensis** Starcke

M. lobicornis lobicornis var. *lissahorensis* Starcke, Tijdschr. Ent., 1927, *70:* 79–80, ☿.

Lissa Hora (Besk.).

For a description of this form see the reference above.

Myrmica lobicornis subsp. **littoralis** Kuznetzov-Ugamskij

M. scabrinodis lobicornis var. *littoralis* Kuzenetzov-Ugamskij, "The Ants of the South Ussuri Region (In Russian)," 1928: 33–36, figs. 15–19, ☿ ♀ ♂.

Worker (after Kuznetzov-Ugamskij): Length 3.6–5.2 mm.

Antennal scape suddenly bent at the base and at the bend lightly striate longitudinally. Epinotal spines shorter than the horizontal surface of the epinotum, the space between them and strongly shining. Metasternal lobes blunt. Reddish brown, head and thorax darker.

Female (after Kuznetzov-Ugamskij): Length 5–5.7 mm.

Color of the body darker than in *M. scabrinodis lobicornis*.

Male (after Kuznetzov-Ugamskij): Length 5–5.4 mm.

Epinotum with two short, broad, pointed teeth (in the typical *lobicornis* they are blunt); the space between strongly shining, but not smooth, being microscopically sculptured. Pilosity somewhat abundant. Color of the body dark, leg joints, tarsi and distal half of the antennal funiculi reddish. (The antennal scape is equal in length to the 7 following segments according to Kuznetzov-Ugamskij's figure).

Type Localities: South Ussuri Region: Okeanskaja, Bassargin, Tigrovaja, Ussuri Station.

Myrmica lobicornis subsp. **lobulicornis** Nylander

M. lobicornis var. *lobulicornis* Nylander, Bull. Soc. Ent. France, 1856: LXXIX, ☿.

Worker (after Nylander):

In this subspecies the lobe at the base of the scape is smaller and less dilated than in the typical form of the species.

Type Locality: France: Mt. Dore.

Nylander described this subspecies from one worker and nothing more is known of its characteristics. Finzi (1926, p. 107) described a worker from England which he believes may possibly be ascribed to it.

Myrmica lobicornis subsp. **pyrenaea** Bondroit

M. arduennae var. *pyrenaea* Bondroit, Ann. Soc. Ent. Belg., 1918, *55:* 106, fig. 53, ☿.
M. lobicornis var. *pyrenaea*, Finzi, Boll. Soc. Adr. Nat., Trisete, 1926, *29:* 108, ☿; Santschi, Rev. Suisse Zool., 1931, *38:* 350, ☿.

For descriptions of this form see the references above.

Myrmica puerilis Stärcke

Myrmica puerilis Stärcke, Nederl. Ent. Ver., 12 Oct. 1942, p. XXVII, ☿ ♀ ♂.
M. scabrinodis var. *atlantica* Stärcke, *ibid.*
M. neglecta Stärcke, *ibid.*

A form from the Netherlands unknown to me.

Myrmica sabuleti Meinert

M. sabuleti Meinert, Kong. Danske. Vidensk. Selsk. Skrift., 1861, *5:* 327, ☿ ♂.
M. scabrinodis var. *bessarabica* Nassonov, Arb. Lab. Zool. Mus. Moscow Univ. (In Russian), 1889, *4:* 36, ☿.

Worker (after Donisthorpe): Long 2¼ lin.

Reddish yellow; gaster darker above. Antennal scape bent almost at right angles, base with a tooth, and on the upper side with a high sharp longitudinal keel. Frontal flaps large, ear-shaped. Frontal portion wholly or partly wrinkled. Sides of head irregularly, thorax and nodes of pedicel distinctly wrinkled longitudinally.

Female: Emery states that it is not possible to distinguish the ♂ and ♀ from those of *scabrinodis.*

Male (after Donisthorpe): Length 2½–2¾ lin.

Black; antennae for the great part, apex of gaster, joints of legs and feet yellow. Antennal scape a third of the length of the funiculus, the last joint longer than the two preceding ones together, often bent or divided in the middle. Antennae almost bare; legs with long, oblique, sub-erect hairs. First node of pedicel wrinkled longitudinally. Wing greyish brown to beyond middle.

Emery (1908, p. 177) believed that *sabuleti* might possibly be identical with the winged pair of ants described by Nylander as *M. granulinodis.*

Distribution: Europe, Central Asia.

Myrmica sabuleti subsp. **americana** Weber

M. sabuleti subsp. *americana* Weber, Lloydia (Lloyd Library, Cincinnati, Ohio), 1939, *2:* 144–146, ☿ ♀ ♂.
M. sabuleti of authors.
M. sabuleti subsp. *trullicornis* Buren, Iowa State Coll. Jour. Sci. *18:* 281–283, ☿ ♀.

Worker: Length 4.5–6.2 mm.

Antennal scape exceeding posterior margin of head by a distance equal to its distal diameter; seen from above, with nearly straight lower margin and slightly sigmoid upper margin, bent distinctly at the distal end, which is about one-third larger in diameter than the proximal end, equipped at the bend with a nearly vertical, high lamina which is prolonged a trifle along the sides; lamina, viewed posteriorly, in the form of an acute tooth; bend at right angles to the scape; joints 1 and 2 of the funiculus together distinctly longer than 3–5 together. Thorax, in profile, slightly convex, with distinct and rounded mesoëpinotal suture; epinotal spines, from the side, distinctly longer than the declivity ventral to them, projected upwards and backwards at about a 55° angle; seen from above, moderately diverging, about one-half longer than the distance between their bases. Petiole, in profile, with concave anterior face meeting the dorsal convex surface at a rounded angle, as long from apex of ventral tooth to postpetiole as it is high; postpetiole, in profile, with nearly plane ventral surface and convex dorsum, as high as long. Gaster ovate. Legs of moderate length.

Surface of head regularly and moderately sculptured; frontal area distinct, finely striate-punctate; clypeus with 10–14 rugae; median dorsal region with regular, comparatively close-set, rugae which diverge

to the posterior angles; posterior surface reticulate, lateral surfaces rugose-reticulate. Thorax coarsely and sharply rugose, slightly vermiculate dorsally. Petiole dorsally with deep, irregular, vermiculations, laterally deeply and more regularly rugose; postpetiole rugose, dorsally somewhat concentrically rugose. Surfaces of body, except gaster, punctate at the base of the sculpturing. Gaster smooth and shining.

Pilosity moderate, hairs coarse, truncate or acute; appendages with moderately coarse, subappressed hairs; no pubescence on legs.

Color of head brown, of thorax and appendages ferruginous, gaster dark brown, lighter apically.

Female: Length 5.2–7 mm.

Similar to the worker and with equally high keel on the antennal scape, which is prolonged slightly more on the posterior side.

Differing in the following: Epinotae, spines shorter than the declivity ventral to them, stout and bluntly tipped. Petiole, in profile, with faintly concave anterior face, slightly longer from apex of ventral tooth to postpetiole than it is high. Postpetiole with plane ventral and convex dorsal surface, distinctly higher than long.

Sculpturing of the head less regular. Pronotum at the sides deeply vermiculate-rugose, reticulate only at the very anterior margin; posterior sides of thorax evenly rugose; scutum of mesonotum with elongate anteromedian smooth area from which radiate fairly even rugosities, somewhat vermiculate on the sides. Pedicel deeply sculptured as in the worker.

Pilosity moderately abundant, partly truncate, partly acute; legs with appressed hairs but without pubescence.

Color of head ferruginous, brownish mid-dorsally; thorax ferruginous with two elongate parapsidal brown blotches on the mesonotum; remainder of body and appendages ferruginous, gaster with a brown transverse, medial band. Wings hyaline with a brownish cast; veins brown.

Male: Length 5.2–6.6 mm.

Antennal scape subcylindrical, somewhat larger in diameter distally, evenly bent at a slight angle at the basal ¼, equal in length to from 4–5 of the following segments together; funicular club indistinctly 4–5–jointed. Epinotal declivity armed dorsally with two distinct subacute or rounded tubercles. Petiole, in profile, with plane anterior face and convex dorsal surface; postpetiole, in profile, one-fourth higher than the petiole, dorsal surface convex, ventral surface nearly plane to slightly convex. Sagittae of the genitalia with 25–31 serrations; volsellae as illustrated.

Surface of head shining, with comparatively numerous rugae, punctate at the base of the sculpturing; thorax shining, abundantly rugose-striate except on the largely smooth scutum of the mesonotum, punctate at the base of the sculpturing; petiole thinly but distinctly rugose, finely punctate basally; postpetiole and gaster smooth and shining.

Pilosity moderately abundant, acute, fine. Appressed pubescence on the antennae and legs.

Color of head blackish brown, remainder of body and appendages dark brown, pedicel and base of gaster, antennal club and tarsi lighter brown. Wings hyaline with a brownish cast; veins brown.

Type Locality: Colebrook, Connecticut, Aug. 16, 24, 1904 (W. M. Wheeler).

Other Localities: QUEBEC: Hull, Kingsmere (W. M. Wheeler); Renfrew (M. Stewart). ONTARIO: Toronto (A. J. Crew, M. Sewell); Renfrew (M. Stewart); Ottawa (no collector); Pelee Is. (M. Talbot); Kingston (A. B. Klugh). MAINE: So. Harpswell, Casco Bay, Sebascodegan Is. (W. M. Wheeler); Kittery Point (Pergande Coll.); Old Town (M. W. Wing). NEW HAMPSHIRE: Mt. Washington (no collector); Durham (Fiske). MASSACHUSETTS: Woods Hole (N. Bagg, K. W. Cooper, A. H. Sturtevant, N. A. Weber); Cuttyhunk (Cockerell); Readville (J. H. E.); Forest Hills, Blue Hills (N. A. Weber, W. M. Wheeler); Newton, Falmouth (A. H. Sturtevant, K. W. Cooper, N. A. Weber); Wellesley (A. P. Morse); New Boston, Berkshire Co. (W. M. Wheeler); Lawrence (U. S. N. M.); Nantucket Is. (Pergande Coll.); Plum Is., Newbury (S. K. Harris); Yarmouth Port (H. Shapley). CONNECTICUT: Colebrook (W. M. Wheeler); New Haven (B. H. Walden); E. Wallingford (R. E. Snodgrass); Devon (N. A. Weber). RHODE ISLAND: E. Greenwich (N. A. Weber). NEW YORK: Carmel, North Castle, Ramapo, Greenville, Hollow, L. I., Ashokan Surv., Mosholu, Bronxville (W. M. Wheeler); Rochester (A. B. Klots); West Farms, New York City (J. Angus); Tuckahoe (no collector); Schenectady (C. F. Turner); Syracuse (E. & G. Wheeler); Fisher's Is., L. I. (U. S. N. M.); Staten I., Croton (A. T. Gaul). NEW JERSEY: Newfoundland (W. M. Wheeler); So. Orange, Fort Lee (no collector); Normandy B. (W. P. Horen); Watchung Mts. nr. Westfield (C. R. Mekeel, N. A. Weber); Caldwell, Camden Co. (U. S. N. M.). PENNSYLVANIA: Rockville, Philadelphia (W. L. Brown); Beatty (U. S. N. M.); Swarthmore Coll., Towanda (N. A. Weber). DISTRICT OF COLUMBIA: Washington (T. Pergande). VIRGINIA: Wallops I. (W. L. McAtee); "Eastern Shore" (U. S. N. M.). TENNESSEE: Cold Spring Mt. (C. A. Dennis). OHIO: North Bass I., So. Bass I. (M. Talbot); Southcentral Region (L. G. & R. G. Wesson); Kildeer Plain (M. E. Amstutz). MICHIGAN: Lansing (A. C. Cole); Mich. Biol. Sta., Flat Rock (M. Talbot).

INDIANA: Tremont, Chesterton (R. E. Gregg); Plymouth (M. R. Smith); Lake Co. (Blatchley); Lafayette (H. O. Deay). ILLINOIS: Champaign (Hart, Weed, A. O. Weese); Billets Sta. (Forbes); Urbana (A. Duke, Hart, Hunt, Martin, McElfresh, Shaml, Terrill, Weed, J. Zetek); Bradford (Kelly); Beach (Frison, Knight, Ross); Cedar Lake, Normal, Galesburg, Centralia, Cuba, Chicago, Bloomington, Quincy (Ill. Nat. Hist. Surv.); Algonquin (W. A. Nason); Hickory Creek, Zion (M. Talbot); Rockford (W. M. Wheeler); Waukegan, La Salle, Momence (R. E. Gregg, D. Lowrie). WISCONSIN: Milwaukee (C. E. Brown); Reedsburg, Madison, Delaven (A. C. Burrill). IOWA: Sioux City (C. N. Ainslie); Ames (W. F. Buren, Pergande Coll.); Boone, Clinton, Keokuk, Jewell, Oak Grove St. Pk., Granite (W. F. Buren). MINNESOTA: North Branch (W. E. Hoffmann); Birchcliff, Lake St. Croix (A. Johnson, N. A. Weber); Park Rapids (N. A. Weber); Duluth (Freeman, Roine, Gregg); Saganaga L. (R. E. Gregg). MANITOBA: Wawanesa, Sidney (N. A. Weber); Auverne (N. Criddle). NORTH DAKOTA: Mikkelson (J. E. Goldsberry); Badlands near Grassy Butte, Stanton, Mercer, Towner, Denbigh, Sterling, Leeds, Rugby, Velva,

Devils Lake, Bismarck, Valley City, Hebron, Belden, Watford City, N. Roosevelt State Park, Kathryn, Pillsbury, Jct. St. Highways 46 and 1 (La Moure Co.) (N. A. Weber); Arvilla, Grand Forks (N. A. Weber, E. & G. Wheeler); Medora, Black and Sentinel Buttes, Killdeer Mts., Glen Ullin, (E. & G. Wheeler); Binford (M. A. Hetland); Coleharbor (H. S. Telford, J. A. Munro). SOUTH DAKOTA: Capa (H. C. Severin). NEBRASKA: "Nebraska" (Pergande Coll.). KANSAS: Topeka (E. G. Titus); Osage City (A. C. Burrill). MONTANA: Helena (W. M. Mann). COLORADO: Colorado Springs, Manitou, Ute Pass, Florissan (W. M. Wheeler); Hartsel, Winfield, Granby (W. S. Creighton); Ouray (U. S. N. M.); Boulder (H. Andrews, W. P. Cockerell, W. S. Creighton, W. M. Wheeler); Roan Mts. (Cockerell); Cebolla (N. A. Weber); White Rocks, Boulder, 5,300 feet (L. F. Byers). IDAHO: Koscow (J. M. Aldrich). UTAH: Park City (U. S. N. M.); Bryce Canyon, Zion Canyon (N A. Weber). NEW MEXICO: Pecos (Cockerell).

The winged castes appear from July to October (Massachusetts: Sept. 24; Connecticut: Aug. 14–24; Illinois: July 13–Oct. 24; Pennsylvania: Oct. 12; North Dakota: Aug. 16–Sept. 11; Colorado: July 9–Aug. 10; Utah: July 26; Arizona: July 28). From a single swarm of winged ants in North Dakota I took both sexes of *americana*, a female of *M. brevinodis* subsp. *brevispinosa* and both sexes of *Lasius niger* subspecies.

Many workers of this subspecies and *fracticornis* Emery can not be separated satisfactorily without the additional evidence of the males. The higher keel or lamina of the scape and its prolongation distally, with the comparatively flat ventral surface of the postpetiole, readily separates most of the *americana* workers from the corresponding slight transverse keel and convex ventral postpetiolar surface in worker *fracticornis*; there are specimens, however, which combine a high keel on the scape with a distinctly convex postpetiole, or a slight keel with a nearly flat ventral surface of the postpetiole. These may be considered transitional in the absence of the males and a possible instance of hybridization.

The worker is readily separated from the worker of the subspecies *nearctica* by the short posterior extension of the keel on the scape and the higher and thinner transverse portion; the ventral surface of the postpetiole is also nearly plane instead of distinctly convex. The males can be readily separated from those of *nearctica* by the longer antennal scape and distinct epinotal tubercles.

BIOLOGY

This subspecies on the whole, is larger, paler and an inhabitant of warmer and dryer situations than either of the subspecies *nearctica* or *fracticornis*.

The nests of *americana* are found under logs or stones and frequently in open situations under grass. The sites are commonly in sunny, dry localities. In North Dakota I have frequently found nests on the open prairie with the nest opening protected by a rather compact collar or slight mound of small pieces of dried plants, such as grass. This collar must protect the opening from being filled by wind-blown sand. Karawajew, at Kiev, U. S. S. R., observed colonies of *M. rugulosa* subsp.

constricta surrounding the nest opening with a similar collar of grass stems. In the valley of the Missouri River in North Dakota, the nests may be found under sandstone slabs on exposed slopes. An unusual nesting site in North Dakota was under an abandoned horse collar on the prairie, illustrating the frequently observed habit of ants in this region of protecting the nest opening. This may tend to hide the nest from predators or to reduce the extremely high moisture evaporation rate from the nest.

A prairie colony with worker brood was taken from North Dakota to the Island of Cuba and kept for over a month at the height of summer with entire success. Many workers were reared in a much hotter and more humid climate than the colony would encounter in North Dakota.

Predators of this subspecies observed at Towner, North Dakota, include the catbird, *Dumetella carolinensis* (L.), feeding on the workers, and thatching ants, *Formica rufa obscuripes* Forel, carrying dead males into their nest (Weber, 1935). The horned lizard, *Phrynosoma brevirostre* (Girard) from Grassy Butte, N. D., fed on *americana* workers at Towner.

Other ants inhabiting the same ecological formation at Towner include *Monomorium minutum minimum* Buckley; *Polyergus rufescens breviceps* Em. with its slave, *Formica fusca subsericea* Say.; *Formica sanguinea aserva* Forel with its slave, *F. fusca subsericea*; and *F. neogagates* Em.

This form is economically somewhat important. I have before me workers which were taken in Illinois attending corn root aphids and others which were reported attending aerial corn "lice." Still others from Illinois were found eating grains of a fallen corn ear and in the vial which was sent to me are several grains with the embryo and a large part of the starch inside the seed coat eaten away. Another collection from Illinois is of workers which were reported as "eating apple fruit." A number of Illinois collections are variously listed as "from volunteer wheat," "from timothy meadow," "in wheat field," "from English Elm," "from corn field," and "attacking sprouting corn." One Illinois record is of the workers eating a carabid larva. In North Dakota I have frequently taken them on the dry short-grass prairie where other insects must be the usual food. In Massachusetts workers of a populous colony on the margin of a road in woods were seen to bring to the inconspicuous nest opening under a bunch of grass a number of insects within a short time. The workers dragged two live beetle larvae and a live *Lasius niger americanus* worker to the nest. Two dealated *Myrmica americana* females with the worker size gasters wandered aimlessly about the opening; the time of year was late May so they must have wintered in the nest, as must have also two additional females dug up with the colony.

ANOMALY

The dealated *Myrmica* queen described and illustrated by Creighton (1928) belongs to this subspecies. "The thorax is joined directly to the gaster, the two petiolar joints having fused with the anterior face of the first gastric segment."

Myrmica sabuleti subsp. **hamulata** Weber

M. sabuleti Meinert ssp. *hamulata* Weber, Lloydia (Lloyd Library, Cincinnati, Ohio), *2:* 146–148, ☿ ♀ ♂.

Worker: Length 3.9–5.2 mm.

Antennal scape, from above, extending barely to the occipital margins, with feebly sigmoid anterior and more sigmoid posterior margin, produced in a distinct bend outwardly at the distal end and inwardly, or medially, at the proximal end; this end with a conspicuous high, thin, lamina extending completely around it and produced proximally in an acute hook; seen from above with a right-angled proximal bend from which the lamina projects medially as a large, acute tooth; antennal club quite distinctly 3-jointed, last segment nearly as long as the two preceding together. Thorax, in profile, convex, with a shallow, obtuse mesoepinotal suture; epinotal spines, in profile, extending upwards and backwards at a 45 degree angle, longer than the declivity ventral to them, slender, acutely pointed; from above, moderately diverging, about 1⅔ longer than the distance between their bases. Petiole, in profile, with anterior face barely concave, meeting the dorsal surface at about a 100 degree rounded angle, a little higher than the distance between the apex of the ventral tooth and the postpetiole; postpetiole, in profile, with convex dorsal and ventral surfaces, about two-thirds as long as high. Gaster ovate. Legs of moderate length.

Surface of the head rather deeply sculptured, several mid-dorsal rugae bounded by vermiculations, becoming reticulate on the sides and posterior surface. Surface of the thorax deeply vermiculate longitudinally, sides more rugose. Petiole deeply vermiculate; postpetiole more rugose, with a narrow mid-dorsal longitudinal band of fused rugae. Gaster smooth and shining. Base of the sculpturing not distinctly punctate.

Pilosity moderately abundant, dorsal hairs mostly truncate; subappressed hairs on the legs; no pubescence.

Color of body dark brown with head and gaster nearly black; appendages brown; hairs bright yellow.

Female: Length 4.9–5.7 mm.

Similar to the worker, with the following differences: Lamina of the antennal scape more erected medially and the hook projected somewhat downward. Epinotal spines shorter than the declivity ventral to them, bluntly tipped. Anteromedian triangular area of the scutum of the mesonotum smooth and shining, from which extend several rugae posteriorly and a moderate number of lateral rounded vermiculations.

Color largely dark brown dorsally and more ferruginous on the sides and appendages. Wings hyaline; veins pale brown.

Male: Length 4.2–5 mm.

Antennal scape equal in length to from 2–3 of the following joints together, bent at the basal ⅓ and incrassate immediately distal to the bend; funicular club indistinctly 5-jointed. Epinotal declivity with two distinct dorsal tubercles. Petiole, in profile, with dorsal surface convex, as long from apex of the slight ventral tooth to postpetiole as it is high; postpetiole nearly 1½ times as high as long, dorsally and ventrally convex. Sagittae of the genitalia with 19–22 serrations, volsellae as illustrated.

Sculpturing of head sparsely and feebly rugose, densely punctate. Dorsal surface of thorax shining, sparsely and feebly rugose, sides more coarsely rugose and punctate. Petiole punctate, with a few feeble rugae; postpetiole and gaster smooth and shining.

Pilosity moderately abundant, acute and fine, subappressed on the appendages.

Color moderately dark brown, head and gaster somewhat darker; wings hyaline, veins pale brown.

Described from a colony of all castes taken by Dr. W. M. Wheeler at Hayne's Canyon, 8,000 feet, Sacramento Mts., New Mexico, July 3, 1917.

This extreme form of *sabuleti* may be separated readily from the subspecies *nearctica* and *americana* by the shorter antennal scape in the male and, in the workers and females, by the unusual prolongation of the lamina of the scape into a hook on the posterior surface.

Myrmica sabuleti subsp. lonae Finzi

M. scabrinodis subsp. *lonae* Finzi, Boll. Sc. Adr. Sc. Nat., Trieste, 1926, *29:* 103–104, fig. 11, ☿ ♀ ♂.
M. scabrinodis var. *lonae* Karawajew, Mem. Acad. Sc. Ukraine, 1929, *13:* 207–208.
M. sabuleti st. *lonae*, Santschi, Rev. Suisse Zool., 1931, *38:* 346–347.

For descriptions of this form see the references above. Judging from a worker sent me it seems to be a *sabuleti* form with an exaggerated development of the keel on the antennal scape.

Myrmica sabuleti subsp. nearctica Weber

M. sabuleti ssp. *nearctica* Weber, Lloydia (Lloyd Library, Cincinnati, Ohio), 1939, *2:* 148–149, ☿ ♀ ♂.

Worker: Length 3.4–4.4 mm.

Frontal carina comparatively large, auriculate and erect. Antennal scapes barely exceeding posterior margin of head; seen from above, straight, subcylindrical, bent slightly outwards distally; with a thickened, subopaque lamina extending the entire distance around the bend and along the posterior margin fully a third the length of the scape, the lamina slightly raised at the bend but horizontal along the posterior margin and even with the top of the scape, the scape at the bend thickened in diameter and slightly produced at the posterior side; scape, from a posterior view, much thickened at the bend, which is nearly right-angled, narrow and compressed distal to the bend, normally shaped at the distal ⅔; joints 1 and 2 of the funiculus together about one-fifth shorter than joints 3–5 together. Thorax, in profile, convex, evenly and distinctly impressed at the mesoëpinotal suture; epinotal spines, in profile, slender, acute, with apices upturned, directed upwards and backwards at a 55–65 degree angle, a little shorter than the declivity ventral to them; from above, slightly longer than the distance between their bases, widely diverging. Petiole, in profile, with slightly concave anterior face meeting the nearly flat dorsal surface at a rounded right angle, about as long from apex of ventral tooth to postpetiole as it is high; postpetiole, in profile, with distinctly convex ventral surface, produced anteriorly, and convex dorsal surface produced posteriorly;

nearly twice as high as long. Gaster ovate. Legs moderately long and slender.

Surface of head largely reticulate-vermiculate, with few longitudinal rugae on the mid-dorsal surface; frontal area distinct, smooth and shining except for sparse punctures. Dorsal surface of thorax coarsely reticulate-vermiculate, mostly reticulate, sides coarsely rugose, vermiculate anteriorly. Petiole moderately vermiculate dorsally, more regularly rugose laterally; postpetiole shallowly rugose, smooth and shining on a mid-dorsal longitudinal area. Base of sculpturing on body, except on gaster, abundantly punctate. Gaster smooth and shining.

Pilosity moderate, comparatively fine, hairs truncate or acute; legs with subappressed hairs; no pubescence.

Color of head from ferruginous to dark brown, thorax also variable but lighter, gaster dark brown, appendages ferruginous to brown.

Female: Length 5–5.7 mm.

Similar to the worker, with the following differences: Antennal lamina, especially at the bend, somewhat raised. Epinotal spines a little shorter and blunter, pointed downwards slightly.

Sculpture of head more regularly rugose. Sides of thorax rugose, anterior margin of pronotum vermiculate-reticulate; scutum of mesonotum with an anterior triangular smooth area, posteriorly followed by several rugae and, laterally, by rounded, open vermiculations. Pedicel deeply rugose, more vermiculate dorsally.

Pilosity moderately abundant, finer and subappressed on the gaster; subappressed hairs on the legs; no pubescence.

Color of head ferruginous, infuscated dorsally; thorax lighter ferruginous, mesonotum with distinct anteromedian and parapsidal brown blotches, several median blotches on the sides; pedicel and appendages light ferruginous; gaster dark brown, wings hyaline; veins light brown.

Male: Length 4.3–4.7 mm.

Antennal scape subcylindrical, slightly incrassate towards the middle, 2½ times as long as wide, shorter than the 3 following segments of the funiculus together; antennal club 4-jointed; epinotal declivity armed dorsally with two low and indistinct tubercles. Petiole a little longer from apex of ventral tooth to postpetiole than it is high, evenly convex above; postpetiole 1½ times as high as long, convex dorsally, less convex ventrally, slightly higher than the petiole. Sagittae of the genitalia with 21–24 teeth; volsellae as illustrated. Gaster ovate. Legs moderately long and slender.

Surface of head somewhat shining, thickly punctate, with sparse, low, rugae. Scutum of mesonotum mostly smooth and shining; sides thickly punctate, margins sparsely rugose; petiole finely punctate; postpetiole and gaster smooth and shining.

Pilosity moderate, erect, coarse, and truncate on the head, thorax and appendages, otherwise largely fine and acute; no pubescence.

Color brown, dark brown on the head. Wings hyaline; veins whitish to brown.

Described from colonies taken by myself 14 miles southwest of Towner, North Dakota, June 5, 1932 (type colony and locality) and at Wawanesa, Manitoba, July 2, 1933. Syntype colonies were taken by

W. M. Wheeler at Cheyenne Canyon and Buena Vista, Colorado. My colonies were both in the woods along the Souris or Mouse River, which drains eventually to Hudson's Bay. The North Dakota colony was discovered on the north and cold slope of a densely wooded ravine (*Populus tremuloides* Michx.) and the nest was in the form of anastomosing chambers under moss. Sept. 5, 1937, the exact site of the Dakota collection was revisited and a small colony was found. The same type of nest was present and the workers became temporarily immobile ("feigned death") when disturbed. Other colonies were found 5 miles north and 6 miles south of Towner. All nests were in wooded areas and the colonies were small.

This subspecies closely resembles the European form; it can be distinguished readily from *americana* by the shorter male antennal scape and the greater development of the lamina on the worker scape.

Other localities: NORTH DAKOTA: Mikkelson (J. E. Goldsberry); Arvilla, Killdeer Mts. (N. A. Weber, E. & G. Wheeler); Grand Forks (L. Monda, N. A. Weber); Grafton, Breien, junction of Cannonball and Missouri Rivers (N. A. Weber). MICHIGAN: Marquette (O. G. Libby), ♂♂ and ♀♀ Aug. 22.

Myrmica sabuleti var. **pilosiscapus** Bondroit

M. pilosiscapus Bondroit, Ann. Soc. Ent. France, 1919: 301, ☿ ♀ ♂.
M. scabrinodis var. *pilosiscapus* Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 102, fig. 10; Santschi, Rev. Suisse Zool., 1931, *38:* 343.

Localities: Doubs, Arosa, ca. 1,900 m. and Graubunden (Finzi). For descriptions of this form see the references above.

Myrmica sabuleti subsp. **scabrinodo-lobicornis** Forel

M. rubra var. *scabrinodo-lobicornis* Forel, Fourmis Suisse, 1874: 77, ☿.
M. sabuleti st. *lonae* var. *scabrinodo-lobicornis* Santschi, Rev. Suisse Zool., 1931, *38:* 347.

This form, which Forel erected as a transition between *scabrinodis* and *lobicornis*, I place here following Santschi who states that he has a good series of it.

Myrmica sabuleti var. **spinosior** Santschi

M. sabuleti var. *spinosior* Santschi, Rev. Suisse Zool., 1931, *38:* 346, ☿ ♀ ♂.

Type Localities: Eastern Pyrenees; Irun; Corse, Poggiolo; Spain; Italy. Type ♂ from Castelnovo, Venetia.

For a description of this form see the reference above.

Myrmica schencki Emery

M. scabrinodis schencki Emery, Zool. Jahrb. Syst., 1895, *8:* 315, ☿ ♀ ♂.
M. schencki Finzi, Boll. Soc. Adr. Sc. Nat., 1926, *29:* 109–111, fig. 14; Santschi, Rev. Suisse Zool., 1931, *38:* 351.

Worker (after Emery, 1908): Length 4–5 mm.

Dark colored, brownish red, head and gaster brown to blackish brown. Sculpturing strong, somewhat as *scabrinodis scabrinodis*, on

the postpetiole finer and weaker. Scape at the bend with a strong, broad transverse lobe, similar in that to *lobicornis*, from the latter form differing in the shape of the petiole, whose node, in profile has not anterodorsally such a clear angle; in this condition *schencki* is intermediate between *scabrinodis* and *lobicornis*. Epinotal spines long as in *scabrinodis*, the infraspinal surface as a rule smooth.

Female (after Emery, 1908): Length 5–6 mm.

Differing from *scabrinodis* and *lobicornis* in the same manner as the worker.

Male (after Emery):

Specimens, which have not been found with workers or females, cannot be distinguished from *scabrinodis scabrinodis*.

Distribution: Middle Europe to Manchuria and China.

Myrmica schencki var. **brunescens** Karawajew

M. schencki var. *brunescens* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 208, ☿.
M. lobicornis var. *brunescens* Santschi, Rev. Suisse Zool., 1931, *38:* 350–351, ☿.

Worker (after Karawajew):

Head thicker and with finer longitudinal sculpturing than in the type, with sharper ventral sculpturing and therefore little shining. Thorax irregularly and less deeply longitudinally wrinkled, especially at the sides. Pedicel more coarsely and irregularly, especially on the petiolar node, rugose longitudinally.

Head and gaster very dark brown, thorax, pedicel and appendages reddish.

Type Locality: North slope of the Caucasus: Teberda, Karatschai-Kreis, 20–25.VII.1927 (Karawajew).

Myrmica schencki subsp. **burtshak-abramovitschi** Karawajew

M. schencki var. *burtshak-abramovitschi* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 209, fig. 4, ☿.
M. lobicornis st. *burtshak-abramovitschi* Santschi, Rev. Suisse Zool., 1931, *38:* 351, ☿.

Worker (after Karawajew): Length 3.5–4.5 mm.

Head and frons as in the type, yet the lobe of the scape is extraordinarily strongly developed, the basal part of the scape also being very massive. The top of the scape at the bend is, in surface view, biscuit-shaped, even, from which the outer part of the lobe is broadly rounded. Epinotal spines long and thin, at the base, however, somewhat thick. The petiole is very short and the anterior edge projects as in *lobicornis*.

The middle of the head is sharply but not deeply sculptured longitudinally, not thickly so that in the posterior section of the frons about 10–15 ridges are present.

Frontal area finely striate but not shining. Thorax very coarsely rugose longitudinally, about 4 rugosities dorsally; the postpetiole is hardly less coarsely sculptured than the petiole.

Very dark brown colored, the gaster (at the apex?) reddish yellow.

"Because of the constriction of the frons I place this variety with *schencki* and not with *lobicornis*. As well as I can judge from Finzi's description this variety comes nearest to var. *obscura* Finzi."

Type Localities: Region of the "Wilden Sees" (Dikoje Osero), Korostenj-Distr., Wolhynien, 28.VII.1927 (N. Burtshak-Abramovitsch). "Nest under a piece of Oligocene sandstone. The region is mountainous, forested and with dense *azalea pontica* vegetation."

Myrmica schencki var. **caucasicola** Arnoldi

M. schencki nat. *caucasicola* Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 172, ☿ ♂.

A form from the Caucasus in Asia unknown to me.

Myrmica schencki subsp. **emeryana** Forel

M. scabrinodis schencki var. *emeryana* Forel, Deutsche Ent. Zeitschr., 1914: 617, ☿.
M. scabrinodis schencki var. *monticola* Wheeler, Proc. Amer. Acad. Arts. Sc., 1917, *52:* 505–506, ☿ ♂.
M. schencki subsp. *latifrons* Starcke, Tijdschr. Ent., 1927, *70:* 84, ☿.
M. schencki of authors.

The following descriptions are drawn from two worker cotypes and from the castes of a single colony from Rockford, Illinois.

Worker (Cotypes). Length 4.5–4.7 mm.

Antennal scapes exceeding posterior margin of head by a distance about equal to their distal diameter; seen from above, in the form of a drawn-out sigmoid curve with the distal end bent outwards and the proximal end, with the lamina, appearing nearly straight; distal diameter nearly twice that of the proximal end; seen from behind it is similarly curved, with the proximal part flaring out into a triangular end and attached at the lowest angle; with a conspicuous lamina, which seen from behind, projects as an apron from the medial side and the dorsomedial angle, being rounded into the dorsal surface; seen from above the lamina is produced over the end of the scape and along the anterior, but not the posterior, side. Thorax, in profile, evenly convex to the deep and obtuse mesoepinotal suture; epinotal spines, in profile, about as long as the declivity ventral to them, directed upwards at an angle of about 45 degrees backwards, acute and with the points upturned; from above, about 1½ times as long as the distance between their bases, diverging. Petiole, in profile, with distinctly concave anterior face forming a right angle with the slightly convex dorsal surface, one-half as long from apex of ventral tooth to postpetiole as high; postpetiole two-thirds as long as high, dorsal surface convex, ventral surface asymmetrically convex, being produced anteriorly. Gaster ovate. Legs of moderate length.

Surface of head rather coarsely sculptured; several irregular rugosities on the dorsal median surface, laterally and posteriorly becoming vermiculate-reticulate, frontal area clearly indicated but completely striate. Dorsal surface of the thorax deeply and longitudinally vermiculate, sides more regularly, but deeply rugose. Petiole deeply and irregularly vermiculate; postpetiole deeply and longitudinally rugose, somewhat fused mid-dorsally. Base of the sculpturing punctate, especially on the head and pedicel. Gaster shining, faintly reticulate.

Hairs moderately abundant and coarse, mostly truncate. Hairs of the appendages more numerous, subappressed.

Color of head dark ferruginous with a brown dorsal blotch; thorax and pedicel ferruginous, appendages lighter; gaster dark brown with lighter apex.

Worker (Illinois Specimens). Length 3.9–5.2 mm.

The lamina on the scape of some is reduced to a lower keel; joints 1 and 2 of the funiculus together are disticntly longer than joints 3–5 together. The epinotal spines may be slightly shorter than the declivity ventral to them, though longer than those of *fracticornis* and distinctly upturned. The median dorsal surface of the head in some is more regularly rugose, though in a narrower area than in *fracticornis*. Hairs of the body may be mostly acute.

Female: Length 5.1–6.3 mm.

Similar to the worker with the usual sexual differences, including the following: Epinotal spines shorter and stouter, in some not curved upwards at the tips. Sides of the pronotum deeply reticulate, sides posteriorly more regularly rugose; antero-median triangular area of the mesonotum smooth and shining, from which radiate posteriorly 4–6 rounded rugae and, laterally, rounded and open vermiculations. Pedicel deeply sculptured, dorsal surface of the postpetiole somewhat concentrically rugose.

Hairs more numerous and acute.

Color of head brown; of thorax ferruginous with a median and parapsidal brown blotches on the mesonotum; a similar blotch on the mesothoracic episternite; gaster brown with lighter base; appendages ferruginous. Wings hyaline with a brownish cast; veins brown.

Male: Length 4.6–5.6 mm.

Antennal scape subcylindrical, slightly bent at the base, one-third as wide as long, equal in length to the following 3 segments together; club of funiculus indistinctly 4-jointed. Epinotal declivity armed dorsally with two slight, obtuse tubercles. Volsellae of genitalia as illustrated; sagittae with 21–25 serrations.

Surface of head shining, densely punctate, feebly rugose-reticulate; thorax shining, nearly completely, though feebly, striate, punctate at the base of the striae; petiole strongly striate, shining, very feebly punctate; postpetiole and gaster smooth and shining.

Hairs moderately abundant, fine, acute.

Color of head black or dark brown, remainder of body dark brown, the pedicel, appendages and tip of gaster paler. Wings hyaline with a brownish cast; veins brown.

Type Localities: Not specified but probably including North Carolina which is mentioned in the original description. Washington, D. C., specimens in the Wheeler collection were labelled cotypes.

Other localities: NEWFOUNDLAND: Bay of Islands (no collector). NOVA SCOTIA: Portaupique, Penobsquis (C. R. Frost); Pleasantfield, North Brookfield (W. H. Prest). MAINE: Casco Bay (W. M. Wheeler); Old Town, Ash Point (M. W. Wing); Monmouth (C. A. Frost); Ocean Pt. (E. & G. Wheeler); Cadillac Mt. top, Mt. Desert I. (J. C. & N. A. Weber). NEW HAMPSHIRE: Mt. Washington (U. S. N. M.); Mt. Monadnock, Mt. Kearsarge, Contoocook (E. & G. Wheeler); Union, Intervale (N. A. Weber). MASSACHUSETTS: Ellisville, Penekese I., Boston (W. M. Wheeler); Forest Hills, Blue Hills (N. A. Weber, G. C.

Wheeler, W. M. Wheeler); Concord, Petersham, Marblehead, Falmouth (N. A. Weber). CONNECTICUT: Colebrook (W. M. Wheeler). ONTARIO: Middle Is., E. & W. Sister Is., Pelee Is. (M. Talbot); West Bay, Manitoulin (C. H. Kennedy); Macdiarmid, Brent, Toronto, (R. O. M. Z.); L. Temagami (A. T. Gaul); Grimsby, Ottawa (no collectors); Renfrew (M. Stewart). NEW YORK: Richf. Spr., Ithaca (U. S. N. M.); Hartsdale (A. T. Gaul); Staten Is., Tuckahoe (no collectors). NEW JERSEY: Matawan, Lakehurst, Halifax (W. M. Wheeler); Morgan (Weiss); Caldwell (U. S. N. M.); Lower Mills (W. L. Brown); Watchung Mts. near Westfield (C. R. Mekeel, N. A. Weber). MARYLAND: Charlton H. (Pergande Coll.); Silver Springs (W. L. Brown). DISTRICT OF COLUMBIA: Washington (Pergande Coll. P.); "Washington" (Forel's cotypes).

VIRGINIA: Warm Springs (U. S. N. M.); "Virginia" (Pergande); Skyline Dr., 3360 ft., Shenandoah Mt. Park (N. A. Weber). NORTH CAROLINA: L. Toxaway (no collector); Mt. Mitchell, 3,400 feet (A. Forel). GEORGIA: Clayton, 2–3,700 feet (W. T. Davis). PENNSYLVANIA: St. Vincent (P. J. Schmitt); Ridley Twp,. Delaware Co. (N. A. Weber); State College, Centre Co. (The Rock), Philadelphia (W. L. Brown); White Haven (Bradley). MISSISSIPPI: Rara-Avis (M. R. Smith). OHIO: E. Sister I., Holland, Willard, Marblehead (M. Talbot); Southcentral Region (L. G. & R. G. Wesson). INDIANA: Miller, Valparaiso, Ogden Dunes, Smith (M. Talbot); Chesterton (R. E. Gregg); Ogden Dunes, Dune Acres (D. Lowrie); Lafayette (H. O. Deay). ILLINOIS: Champaign (Hart); Havana (Hart & Brown); Urbana (Hart, Farrar); Billets Sta. (Forbes); Peoria L. (Pergande Coll.); Galena, Freeport, Apple R., Can. State Park (Ross & Townsend); White Heath (H. H. Ross); Charlestown (Ross & Mohr); Marshall (Peppoon & Mohr); Oakwood (T. H. Frison); Hickory Creek, Palos Park (M. Talbot); Rockford (W. M. Wheeler). MICHIGAN: Warrens Dunes, Flat Rock (M. Talbot, C. H. Kennedy). IOWA: Spirit L., Boone, Clinton, Sabula, Inwood (W. F. Buren); Ames (W. F. Buren, T. Pergande).

WISCONSIN: Madison (A. C. Burrill); White Fish Bay (W. M. Wheeler); Superior, Foxboro (R. E. Gregg). MANITOBA: Treesbank (C. G. Hewitt); The Pas (R. H. Daggy). MINNESOTA: North Branch (W. E. Hoffmann); Itasca Park (E. & G. Wheeler); Red L. (Beltrami Co.), Shell L. (Becker Co.), Big Sand L. (Hubbard Co.) (N. A. Weber); Birchcliff, Lake St. Croix (A. Johnson, N. A. Weber); Duluth (Freeman, Roine, Gregg); Rice L., Holyoke, Knife R., Saganaga L. (R. E. Gregg). NORTH DAKOTA: Mikkelson (J. E. Goldsberry); Kelly, Turtle Mts., Bicycle, Arvilla, (E. & G. Wheeler); Towner, Bismarck, Sioux Co. nr. Breien, Kildeer Mts. (N. A. Weber); Cass Co. (C. Schonberger); Inkster, Manvel (C. V. Johnson). SOUTH DAKOTA: Hill City (Pergande Coll., N. A. Weber); Deadwood, 5,000 feet (E. & G. Wheeler). KANSAS: "Kansas" (G. F. Gaumer). WYOMING: Devils Tower (W. S. Creighton). COLORADO: Rocky Mt. Nat. Park; Glacier Basin Camp. (N. A. Weber); Custer Co. (T. D. A. Cockerell); Granby (W. S. Creighton); "Colorado" (U. S. N. M.); Manitou, Florissant, Cheyenne Canyon, Buena Vista (W. M. Wheeler). NEW MEXICO: Cloudcroft, 9,000 feet, Cox Canyon, 9,300 feet, Sacramento Mts. (W. M. Wheeler). ARIZONA: Coconino Forest (W. M. Wheeler); San Francisco Mts., 13,000 feet (W. M. Mann); Jacobs L., Kaibab Forest (N. A. Weber). MONTANA:

Bear Paw Mt. (Pergande Coll.); Flathead Lake (W. S. Creighton). IDAHO: Moscow (J. M Aldrich). UTAH: Lehi (W. A. Kooker); Bryce Canyon, 8,100 feet (N. A. Weber).

The winged forms appear from July to September (Connecticut. Aug. 24–29; New York: Sept. 26; Ohio: Aug. 1–Sept. 21; Ontario: Aug. 3–Sept. 5; Illinois: July 27–Aug. 15; South Dakota: Aug. 9; North Dakota: July 25–Aug. 8; Saskatchewan: July 15; Montana: Aug. 23; Arizona: July 21–28; New Mexico: July 3–9; Utah: July 26).

This subspecies is comparatively distinct in the possession of a high lamina along the anterior margin of the bend and base of the antennal scape in the worker and of short antennal scapes in the male. Males are occasionally found, however, with these short scapes in colonies containing workers and females much like *fracticornis* and there is the usual variation in body structure in all castes in other colonies. The antennal scapes of the worker may be considerably compressed at the bend and the lamina reduced to a slight postero-medial carina; the epinotal spines may be distinctly shorter than the declivity ventral to them and may be straight, without deflected apices.

The variety *monticola* has been synonymized after the examination of all the type specimens. I cannot clearly separate them from the *emeryana* specimens from Illinois. Comparable ants from many localities in the East and the West are before me and agree well with the *monticola* descriptions and specimens.

The subsp. *latifrons* Starcke, which was described from four workers from Buffalo, N. Y., has been synonymized after the examination of the original description and of a figure of the antennal scape in "De Levende Natuur" (1927, fig. 49) which was labeled "*M. schencki* (Buffalo, metatype)", but of which Stärcke wrote "This is my *latifrons*." The description and the figure agree well with my specimens of *emeryana* from New York.

BIOLOGY

Myrmica emeryana usually nests in moist and shady situations. As a rule it inhabits ecological niches intermediate between the sunny, well-drained sites of *americana* and the damp to swampy places preferred by *brevinodis*. The ants are often found in woods forming irregular chambers in the soil, but may nest among grass roots. The entrance is sometimes protected by a collar of plant fibers, a more common feature of *americana* nests, however. The ants also make use of fallen branches, boards or stones to conceal the nest entrance and conserve humidity. The ants are timid, "feigning death" when disturbed, and are generally slow-moving.

Myrmica schencki var. kutteri Finzi

M. schencki var. *kutteri* Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 111, ☿.

Switzerland: Zermatt (H. Kutter).

For a description of this form, see the reference above.

Myrmica schencki var. **obscura** Finzi

M. schencki var. *obscura* Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 111–112, ☿ ♀ ♂.

Venezia Guilia: Mt. Nanos, Mt. Castellaro; Hungary: M. Tatra. For a description of this form see the reference above.

Myrmica schencki var. **plana** Karawajew

M. lobicornis var. *plana* Karawajew, Konowia, 1926, *5:* 283–285, fig. 1, ☿.
M. schencki var. *plana* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 208, 209, ☿.

Worker (after Karawajew):

Head broad, the occipital margin more even than in *M. sulcinodis*. Scape surpassing the occipital margin; at the base almost evenly bent and with an acute, somewhat long, angle on the bend. Dorsal surface of the thorax quite lacking a clear mesoëpinotal impression. Epinotal spines moderately long, thin, somewhat acute apically, situated at about 45 degrees from the basal surface. Petiolar node with a somewhat rounded angle and a concavity on the anterior face, followed by a convexity basally. Postpetiole broadened posteriorly, somewhat broader than long, in profile the upper convexity is not equalled ventrally. Sculpturing coarser than the type (*M. lobicornis*), on the dorsal surfaces of the head and thorax coarse longitudinal rugosities. Pedicel somewhat coarsely wrinkled. Otherwise similar to the type (*M. lobicornis*). Color dark brown-ferruginous.

Type Locality: Taurish Gouv.: New Askania (Spat and Dobrschansky).

"I think the var. *plana* must be placed with *schencki* E. for, although the frons of this variety is not as strongly narrowed as in the type, yet the outer borders of the frontal carinae are more strongly curved outwards."

Myrmica schencki var. **salina** Ruzsky

M. scabrinodis var. *salina* Ruzsky, Formic. Imp. Rossici, 1905: 687, ☿ ♀ ♂.

Worker (after Ruzsky and Emery): Length 4.7–5 mm.

Frontal carinae much broadened in the form of lobes; lobe of scape less oblique than in *scabrinodis*, more than in *lobicornis*; surface between the reticulations on the sides of the head punctate but shining; middle part of the clypeus smooth, shining. Epinotal spines long, straight. Color somewhat dark.

Female (after Ruzsky): Length 5–6 mm.

Similar to the worker but colored somewhat darker. Wings brownish on the basal half.

Male (after Ruzsky and Emery):

Sculpturing of the head weaker than in the typical form, punctate-rugulose. Antennal scape thickened in the middle. Pilosity less dense, wings as in the female. Antennal scape lengthened as in the typical *scabrinodis*.

Type Locality: Gouv. Orenburg: Tobolsk.

Emery saw the type specimens and believed them a transition from the typical *scabrinodis* to *schencki*.

According to Ruzsky this ant lives beside salt lakes in deep holes in

the earth. The nests have one or more openings surrounded by a little mound of soil and small dried-up pieces of grass. In Siberia, at Lake Gorki, he found a nest among dried bushes, the cavities goind deep into the earth. In the salt region of Tsara-Kul he found the nests in cavities in the soil among bushes (*Saussurea amara*).

Myrmica schencki subsp. **spatulata** M. R. Smith

Myrmica schencki spatulata Smith, Ann. Ent. Soc. Amer., 1930, *23:* 566–7, figs. 1–4, ☿ ♀.

Original Description.

Worker: Length 4.3–4.6 mm.

"Head, excluding mandibles, distinctly longer than broad, with rounded posterior border and posterior angles and convex sides. Eyes prominent, oval, convex, placed at a distance from the mandibles greater than their largest diameter. Mandibles well-developed, triangular, with 7 or 8 distinct teeth, the apical 3 the most strongly developed. Clypeus strongly convex; viewed laterally, it is decidedly protuberant. Frontal area triangular, impressed. Antennae 12-segmented; scapes robust, surpassing the posterior border of the head, each with a very large lobe at its base, which when viewed from above is very large and strikingly spatulate in outline; funiculus each with the last 3 distal segments enlarged but scarcely forming a distinct antennal club. Thorax viewed laterally with a distinct pro-mesonotal suture, the mesoëpinotal region strongly impressed dorsally, less so laterally, but not forming a distinct suture. Epinotal spines long and acute, directed backward and upward, the spines about as long as the face of the declivity of the epinotum. Petiole, viewed in lateral profile, with flattened superior surface which meets the anterior surface in an almost distinct right angle; below with a short, blunt, anteriorly projecting spine. Postpetiole viewed from the same profile as the petiole, wider dorso-ventrally than antero-posteriorly. Gaster from above oval, the apex with a distinct sting.

"Mandibles, clypeus, frontal area, declivity of epinotum, appendages and gaster shining; remainder of body subopaque. Mandibles coarsely and longitudinally striated; clypeus similarly sculptured. Head coarsely rugulose-reticulate with finely punctate interspaces. Thorax and petiole coarsely rugulose, the rugulae with a distinct longitudinal trend.

"Pilosity yellow; coarse, suberect to erect, moderately abundant over all parts of the body, more reclinate on the legs. Pubescence of the same color as the pilosity, closely appressed to the body and so sparse as not to obscure the surface.

"Color highly variable in different specimens, in general, yellowish-brown to reddish-brown; appendages lighter, gaster black. The dorsum of the head, thorax, petiole and postpetiole more or less irregularly infuscated and as a rule darker than the rest of the body except the gaster.

Female: Length 5.5–6 mm.

"Very similar to the worker in all respects but proportionally larger. The head bears three not very distinct occlli, which are arranged in a

nearly equilateral triangle. The sculpturing of the body although similar to that of the worker is much coarser. On the thorax, especially the sides, the rugulae are regular, almost equidistant, and have a longitudinal trend.

"Pilosity and pubescence hardly distinct from that of the worker.

"Color much deeper than that of the worker; dark reddish-brown, with the infuscation on the dorsal surfaces of the body darker, thus giving the ant from above a blackish appearance.

"Described from 6 workers and 4 dealated females, all of which were taken from a nest in the soil in a low heavily-wooded area, subject to occasional inundations, 5 miles west of Starksille, Mississippi. Cotype in the collections of the Department of Entomology of the Mississippi A. & M. College, the collection of Dr. W. M. Wheeler, and my collection."

This subspecies is known only from the type locality and from Rara-Avis in the same state and the males have not yet been described. Transitions between this subspecies and ***americana*** from Rockford, Illinois, and from Colorado are in Dr. Wheeler's collection.

Myrmica schencki var. **starki** Karawajew

M. schencki var. ***starki*** Karawajew, Acad. Sc. Ukraine, 1929, *13:* 208, ☿; Zool. Anz., 1931, *93:* 29, ☿.

Worker (after Karawajew):

Head coarsely and longitudinally sculptured, laterally and posteriorly coarsely reticulate, with sharply impressed basal sculpture, somewhat shining. Thorax coarsely, irregular, especially on the dorsal surface, longitudinal sculpturing. Petiole, from above, very coarsely and sharply wrinkled in which a longitudinal trend can scarcely be distinguished; the postpetiole longitudinally and finely sculptured.

Dark brown, thorax and pedicel barely reddish, appendages likewise reddish, hardly lighter than the thorax.

Otherwise as in the type.

Type Localities: Chibinic Mt. (Kolskij Peninsula), Border along, also tundra by, the Imandra Sea, 14, 22.VII.1928 (V. Starck). Baikal Sea Region: Tanchoj-Mischicha, Listwenitschnoje (W. Karawajew).

"Apparently nearest the var. ***obscura*** Finzi."

Myrmica schencki var. **subopaca** Arnoldi

M. schencki vat. *subopaca* Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 172, ☿.

A form from the U. S. S. R. unknown to me.

Myrmica schencki subsp. **tahoensis** Wheeler

Myrmica scabrinodis schencki var. *tahoensis* Wheeler, Proc. Amer. Acad. Arts and Sciences, 1917, *52:* 504, ☿ ♀ ♂.

Original Description:

"Small; antennal scapes geniculately bent at the base and at the flexure with a small rounded lobe, appearing as an acute tooth when the

scape is seen from the side. Frontal area very distinct, triangular. Frontal carinae large, lobular. Epinotal spines slightly shorter than the base of the epinotum, as long as their distance apart at the base, rather slender, distinctly curved downwards at their tips. Petiole in profile blunt and rounded above.

"Head, thorax and pedicel very coarsely and in the main longitudinally rugose, the surface subopaque; frontal area opaque, finely and densely longitudinally rugulose; concavity of epinotum smooth and shining like the gaster.

"Hairs rather long, abundant and suberect on the body and legs as in the typical *schencki* var. *emeryana* Forel.

"Head and gaster black; mandibles, antennae, thorax petiole and post-petiole deep brownish red; legs slightly more yellowish red.

Female (dealated): Length 4.5–5 mm.

"Very similar to the worker; pronotum transversely, mesonotum and scutellum strongly, pleurae more feebly longitudinally rugose; petiole and postpetiole longitudinally rugose above, densely and finely punctate on the sides and below as in the worker. Color like that of the worker, except that the thoracic dorsum and some spots on the pleurae are black.

Male: Length 3.5–4 mm.

"Antennae very short, the scapes especially, which are feebly bent at the base and no more than three times as long as broad and shorter than the three basal funicular joints together; club 4-jointed. Frontal area large, distinct, triangular. (Sagittae of the genitalia with 21–23 serrations; volsellae as illustrated). Sculpture and pilosity much as in the variety *emeryana*. Color dark brown; head black; mandibles, tarsi and articulations of legs brownish yellow; palpi whitish. Wings pale hyaline throughout, not infuscated at the base as in *emeryana*.

"Described from numerous workers, several males and two females from several localities about Lake Tahoe (Tallac, Angora Lake, Glen Alpine Springs, Fallen Leaf Lake) (California, July 24–28, 1915). The colonies are small and nest under stones in shady places."

Dr. Wheeler collected this handsome subspecies again on July 23, 1917, at Alta Meadow south of Lake Tahoe, California. The antennal scape in the males of this collection varied in length to the equivalent of from 3–4 of the following joints together.

Myrmica rugulosa Nylander

M. rugulosa Nylander, Act. Soc. Sc. Fennicae, 1849, *3:* 32, ☿ ♀ ♂; Finzi, Boll. Soc. Adr. Sc. Nat., Trieste, 1926, *29:* 91–93, fig. 4; Starcke, De Levende Natuur, 1927, 13, fig. 42.

M. scabrinodis rugulosa Karawajew, Konowia, 1926, *5:* 285; Kuznetzov-Ugamskij, Zool. Anz., 1929, *83:* 45.

Worker (after Nylander, 1856): Length 3.5–4.3 mm.

Similar to the preceding (*M. ruginodis*) but smaller, more opaque, paler, frontal area indistinct.

Female (after Nylander, 1856): Length 5.5–6 mm.

Similarly distinct from the preceding female, frontal area inconspicuous, pedicel less rugose; epinotal spines as long as in the worker.

Fore wings 5 mm. long, from the base to the middle very lightly lutescent.

Male (after Nylander, 1856): Length 4.5–5 mm.

Similar to the male of *M. scabrinodis*, pilosity of the tibiae much shorter, decumbent; mandibles about 5-dentate; scape as long as the first three joints of the funiculus.

Distribution: North and Middle Europe; Daghestan.

Myrmica rugulosa subsp. **caucasica** Arnoldi

M. rugulosa subsp. *caucasica* Arnoldi, Folia Zool. et. Hydrobiol. (Riga), 1934, 6(2): 165, ☿♂.

A form from the U. S. S. R. unknown to me.

Myrmica rugulosa subsp. **constricta** Karawajew

M. rugulosa var. *constricta* Karawajew, Travaux Syst. et faun., Ukrainian Acad. Sci., Kiev, 1934, p. 74.

M. rugulosa var. *minuta* Karawajew, Acad Sc. Ukraine, 1929, *13:* 204, ☿ ♂, (nec *M. laevinodis* var. *minuta* Ruzsky, Formic. Imp. Rossici, 1905: 670, ☿).

Worker (after Karawajew): Length 3–3.5 mm.

Frons as in the var. *ruguloso-scabrinodis* Karawajew, sculpturing weaker than in the type, color lighter and more even, the gaster hardly darker than the rest of the body.

Male (after Karawajew): Length 4 mm.

Scape as long as the three following joints together; these latter of a length comparative with those of the var. *ruguloso-scabrinodis*. Length of the fore wings: 4 mm.

Type Localities: Kiev region, on both sides of the Dneiper, pine forest behind Nikolskaja Slobodka, 1.VIII. 1919 (W. Karawajew).

These came from a hilly region; the nest, without a mound, was under coarse grass in sandy ground. About the entrance were arranged bits of reeds and grass stems in oblique positions. Upon digging up the colony and transferring it to an artificial nest he found two queens which were lost in the intervening years.

Similarly in North Dakota I found *M. sabuleti* subsp. *americana* surrounding the nest opening with a collar of grass particles.

Myrmica rugulosa var. **hellenica** Forel

M. scabrinodis rugulosa var. *hellenica* Forel, Rev. Suisse Zool., 1913, *21:* 431, ☿ ♀.

Worker (after Forel): Length 3–5 mm.

Frontal area completely and densely striate as in *sulcinodis* Nyl. but the size and general aspect are those of *rugulosa*, likewise the form of the scape.

Female (after Forel): Length 4–5 mm.

Same differences as in the worker.

Type Localities: Greece: Patras, Corfou.

Myrmica rugulosa subsp. **limanica** Arnoldi

M. rugulosa subsp. *limanica* Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 162, ☿ ♀ ♂.

A form from the U. S. S. R. unknown to me.

Myrmica rugulosa limanica var. **chersonensis** Arnoldi

M. rugulosa limanica nat. *chersonensis* Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 164, ☿ ♂.

A form from the U. S. S. R. unknown to me.

Myrmica rugulosa limanica var. **strandi** Arnoldi

M. rugulosa limanica nat. *strandi* Arnoldi, Folia Zool. et Hydrobiol. (Riga), 1934, 6(2): 164, ☿.

A form from the U. S. S. R. unknown to me.

Myrmica rugulosa var. **slobodensis** Karawajew

M. rugulosa var. *slobodensis* Karawajew, Travaux Inst. Zool. Biol., Kiev, 1936.

A form from the U. S. S. R. unknown to me.

Myrmica rugulosa subsp. **ruginodiformis** Karawajew

M. rugulosa var. *ruginodiformis* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 204–205, ☿ ♀ ♂.

Worker (after Karawajew): Length 3.5–4 mm.

Epinotal spines clearly shorter than in the type. The clypeus, in many examples, strongly triangular, the apex, however, being rounded. Head and gaster dark brown.

Female (after Karawajew): Length 5–5.5, mm.

Color as in the worker, except that on two of the examples the middle of the posterior half of the mesonotal scutum and the scutellum are reddish yellow. In the other specimens these areas are prolonged anteriorly and appear as three dark stripes. Fore wings 5.5 mm. long. Otherwise as in the worker.

Male (after Karawajew): Length 4.5–5 mm.

Scape somewhat longer than the 5 following segments together. Epinotum with weak, blunt gibbosities. Petiole conic, with rounded node.

Sculpturing comparatively fine and somewhat irregular, the pedicel dorsally smooth and shining, the sides finely and longitudinally striate. Dark brown, the antennae and legs somewhat lighter, the mandibles yellowish. Fore wings 4.5 mm. long.

Type Locality: Karkara, east of Issyk-kul, upper course of the Kegeni River, 1,950 meters, 16.VIII.1925. (N. Kuznetzov-Ugamskij).

Taken on a mountain steppe among *Festuca*.

The male of this form has so much longer antennal scapes (equal to the 5 following segments instead of 3), that it may belong to another species.

Myrmica rugulosa var. **rugulosa-scabrinodis** Karawajew

M. rugulosa var. *rugulosa-scabrinodis* Karawajew, Acad. Sc. Ukraine, 1929, *13:* 205, 206, fig. 1, ☿ ♂.

Worker (after Karawajew):

Differing from the type in that the frontal carinae are somewhat divergent and at the apices somewhat thicker.

Male (after Karawajew): Length 4.5–5 mm.

Scape as in the type, as long as the 3 following segments together. The 1st segment (of the funiculus), on the outside, is quite as long as the 2nd, which is much thinner, the 3rd is two-thirds as long as the 2nd. Anterior division of the mesonotum between the Mayrian furrow is smooth and shining, lateral divisions finely striate longitudinally, the scutellum coarsely striate longitudinally, the postpetiole almost entirely smooth and shining.

"I think this is the form which Ruzsky (1905) regarded as the typical form from the Caucasus."

Type Localities: Caucasus: Mzymta River, Tshernomorskij Kreis, 10.IX.1910, ☿ ☿ and 1 winged ♂ (Satunin); Georgijevski-Osetinskij Aul, Kuban Region, 28.VII.1903, ☿ ☿ and 2 ♂ (Koznakov and Dieterich); Jailatsch-Chaman-Tshaj, 6,000 feet, Betsho, Tshaba, Svanetien, Shusha, Gouv. Jelisavetpol; Sotshi, Tshernomorskij Kreis; Armenia: Goktsha, Sevan peninsula.

ANNALS

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MORPHOLOGY, HABITS, AND SYSTEMATIC POSITION OF ALLEPEIRA LEMNISCATA (WALCKENAER)

(Araneida: Argiopidae, Allepeirinae)

HARRIET EXLINE,[1]
Rolla, Missouri

Allepeira lemniscata (Walckenaer), a spider of the Southern United States and Cuba, builds a domed orb-web that is unique among the Argiopidae. It differs from other members of the family in various habits, and morphologically is not closely related to other argiopid genera.

The history of the species reflects the uncertainty regarding its systematic position. Described under *Linyphia* Latreille (Walckenaer, 1842; Hentz, 1850), it later was referred to *Epeira* Walckenaer (McCook, 1878) and to *Argiope* Andouin (Marx, 1890). It is the genotype of *Hentzia* McCook (1889) (preoccupied by Marx, 1883), and of the substitute name *Allepeira* Banks (1932). The genus was compared with *Leucauge* White by McCook (1889) and others, both genera having been placed in the Metinae. Marx (1890) placed the species in *Argiope* and the subfamily Argiopinae, Simon (1895) and Petrunkevitch (1928) in the Araneinae. Currently Banks (1932) and Bryant (1940) have referred both *Allepeira* and *Leucauge* to the Tetragnathinae.

The present study is an outgrowth of field observations of *Allepeira lemniscata* in the vicinity of Austin, Texas, and of efforts to find a satisfactory systematic position for that species. The following are its main contributions:

(1) Previous observations of the habits of *A. lemniscata* have been verified, and some new observations added.

(2) Morphological results include:

a) Description in detail and illustration of the external morphology.

b) Description in detail and illustration of male and female genitalia, suggesting the generic and subfamily significance of their characters as a basis for revisionary studies of the Argiopidae.

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c) Detailed description of the spination of the legs, with a variation study of spines of the first leg based on 12 specimens, indicating a need for caution in the taxonomic application of this character.

(3) A new subfamily Allepeirinae is proposed, to stand between the Metinae and Argiopinae in the family Argiopidae.

Acknowledgments.—I am indebted to Elizabeth B. Bryant for the loan of Cuban material from the Museum of Comparative Zoology, Harvard University, and for literature; to Allan F. Archer for bibliographic references; to Sarah B. Martin for assistance with the drawings and help in making field observations; and to the Department of Zoology, The University of Texas, for laboratory and library facilities.

Genus **Allepeira** Banks

Hentzia McCook, 1889, American Spiders, 2, p. 244. F. O. P. Cambridge, 1904, Biol. Centr. Amer., Arachnida, 2, p. 523. (Not *Hentzia* Marx, 1883.)
Allepeira Banks, 1932, *in* Banks, Newport, and Bird, Univ. Oklahoma Publ., Biol. Survey, 4 (1): 23.

Genotype.—*Epeira basilica* McCook, = *Alleperia lemniscata* (Walckenaer) (by substitution).

Diagnosis.—Posterior eye-row almost straight, slightly procurved, with eyes equidistant; median eye area almost square; anterior median eyes farther from each other than from lateral eyes. Chelicera normal, with boss (sometimes inconspicuous). Maxilla almost as broad as long; lip broader than long. Legs long with metatarsi appreciably longer than tibiae, and tarsi longer than patellae; with numerous long, slender spines. Trichobothria present in two rows on basal half of each tibia, one on each metatarsus, none on femora. Abdomen elongate, cylindrical; female with anterior dorsal humps; posterior tip of abdomen produced slightly above and behind spinnerets. Chitin over booklungs only slightly furrowed. Colulus large. No sexual dimorphism in size and pattern, and male without specialized apophyses or spines. External genitalia complex.

The genus contains at present only *A. lemniscata* and *A. trivittata* (O. P. Cambridge) (1890, as *Argiope*).

Comparisons.—The body shape is somewhat similar to that of some of the larger species of *Linyphia*, although the abdomen is thicker at the posterior end and the legs bear many more spines. It also is somewhat similar to *Leucauge* and *Argiope*.

The position and spacing of the eyes are like those in *Leucauge* and the Metinae. In the Argiopinae, the posterior row of eyes is greatly procurved, rather than straight. The Tetragnathinae, as typified by *Tetragnatha*, have widely separated lateral eyes. In the Araneinae, the median eyes are much closer to each other than to the lateral eyes.

The chelicerae, maxillae, and lip are most nearly like those of the Argiopinae. The boss on the chelicera is not as distinct as in the Araneinae, but more pronounced than in the Metinae. The maxillae are not elongate nor enlarged distally as in *Tetragnatha* and *Leucauge*.

The proportions of the leg segments are the same as those of *Argiope*, unlike those of the Araneinae and Metinae. The spines are long and

slender, not stout as in the Araneinae. The absence of femoral trichobothria dissociates *Allepeira* from *Leucauge* and the Tetragnathinae.

The morphological significance of the furrows in the chitin, covering the book-lungs in most argiopid spiders, is not clear. They are absent in the Tetragnathinae, vestigial in *Leucauge* and the Metinae, well developed in the Argiopinae, and conspicuous in most of the Araneinae. In *Allepeira* a slight furrowing is developed.

The male and female of *Allepeira* are similar in shape, size, color, and pattern. The female is slightly larger and bears abdominal humps that are lacking in the male. Argiopids are not particularly consistent in degree of sexual dimorphism, but marked differences are usual. Size differences in the Tetragnathinae are not great, but the armature of the male chelicerae is often greater than in the female. Dimorphism in size is considerable in some species of *Leucauge*. In the male of *Meta curtisi* (McCook), the chelicerae are enlarged. The male and female of *Argiope* differ greatly in size, and the shape of the abdomen is different in the two sexes. Most male Araneinae bear specialized apophyses, spines, or both on the legs, and in many species the male is much the smaller.

The male palp of *Allepeira* is comparable to that of the Argiopinae and Araneinae rather than of the Tetragnathinae or Metinae. The patella and tibia are short segments, the former bearing a long, bristle-like spine. The paracymbium is vestigial, reduced to an immovable basal hook on the cymbium. (See figures 9–11.)

The genitalia of the female more closely ally the genus to *Argiope* than to *Meta*, *Leucauge*, or *Aranea; Tetragnatha* has no external genitalia. In *Allepeira* the genitalia are more highly specialized than in *Meta* or *Leucauge*, less so than in *Aranea*. The atriolum (see fig. 7) is arched and highly chitinized, but not produced posteriorly into an epigynum.[2] Internally there is a flattened, lightly chitinized bursa, homologous to the heavily chitinized bursa of *Argiope*. The spermathecae are more complex than in *Argiope*, and are double.

Allepeira lemniscata (Walckenaer)

Linyphia lemniscata Walckenaer, 1842, Hist. Nat. Ins. Apt., 2, p. 263.

Linyphia conferta Hentz, 1850, Boston Soc. Nat. Hist., Jour., 6: 30, pl. 4, fig. 7; 1875, Boston Soc. Nat. Hist., Occasional Papers, 2, p. 135, pl. 15, fig. 7, pl. 19, fig. 115 (reprint of 1850 figures).

Epeira basilica McCook, 1878, Acad. Nat. Sci. Philadelphia, Proc., pp. 124–134, figs. 1–3.

Argiope basilica (McCook). Marx, 1890, U. S. Nat. Mus., Proc., 12: 541.

Hentzia basilica (McCook). McCook, 1889, American Spiders, 1, pp. 164–165, 168–171 (text-figures); 1893, American Spiders, 3, p. 244, pl. 14, fig. 2, pl. 23, fig. 8. F. O. P. Cambridge, 1904, Biol. Centr. Amer., Arachnida, 2, p. 523. Petrunkevitch, 1911, Amer. Mus. Nat. Hist., Bull., 29: 349–350. Comstock, 1913, Spider Book, pp. 416–418, fig. 430 [1940, *revised ed.*, pp. 430–432, fig. 430]. Petrunkevitch, 1928, Conn. Acad. Arts and Sci., Trans., 29: 138.

Cyrtophora basilica (McCook). Simon, 1895, Hist. Nat. Araign., 1 (4), p. 771.

Allepeira basilica (McCook). Banks, Newport, and Bird, 1932, Univ. Oklahoma Publ., Biol. Survey 4 (1), p. 23. Bryant, 1940, Mus. Comp. Zool., Bull., 86 (7): 358.

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[2]The atriolum of *Argiope* is considerably produced posteriorly in a scape-like epigynum, and is highly chitinized throughout. Figures of *Allepeira trivittata* (O. P. Cambridge) (1890, pl. 4, figs. 6c, 6d, as *Argiope;* F. O. P. Cambridge, 1902, pl. 51, figs. 13, 13a, as *Hentzia*) show the epigynum of that species produced as in *Argiope*.

Allepeira conferta (Hentz) Archer, 1940, Geol Survey Alabama, Alabama Mus. Nat Hist, Mus Paper 14, p 24, 1941, *ibid*, 18, pp 11–12
Allepeira lemniscata (Walckenaer) Chamberlin and Ivie, 1944, Univ of Utah, Bull, 35 (9): 93–94

Type—The type specimen of *Linyphia lemniscata* Walckenaer presumably was not preserved It is illustrated by number 25 of Abbot's unpublished drawings (Kensington Museum of Natural History, London), which has been examined by Chamberlin (Chamberlin and Ivie, 1944).

Type locality.— "Burke County" (now part of Screven County), Georgia.

Range.—Dense populations of *Allepeira lemniscata* occur in scattered localities throughout the Southern States, Texas, Oklahoma, Colorado, and Cuba.

DESCRIPTIONS

Female.—Total length, 8 73 mm (mature females from Austin vary from 6 5 to 8.8 mm.; females from Cuba, 8 1 mm.); length of carapace, 3.06 mm.; width of carapace, 2.25 mm.; height of carapace, 1 08 mm.

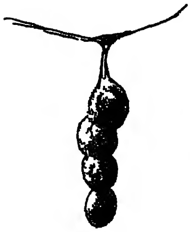
Color of living spiders considerably brighter than when preserved in alcohol. Living specimens: cephalothorax bright yellow with a narrow, median, black, longitudinal band, sides black. Legs pale green, almost transparent, grading to reddish brown; with many spines; clothed with short, black and white hairs; femora with narrow, black, dorsal stripe. Abdomen dorsally figured with a wide, irregular folium from base to tip, outlined in white; folium brilliantly colored anteriorly with red, yellow, black, and white, posteriorly with red and tan, becoming black toward tip. Sides with three green and black, irregular, longitudinal stripes, separated by white bands. Sternum black, with a broad, irregular, median, yellow stripe. Venter of abdomen marked with a broad, median, black stripe, inclosing yellow patches, and outlined in white and yellow. In alcohol, nearly all the colors lose brightness, and the green and red become gray

Carapace broad in thoracic part, narrowed just behind eyes, flat with a pit-like thoracic groove and shallow cephalic grooves. Head region with nearly parallel sides and quite rounded in front.

Eyes similar in color, anterior medians largest Anterior row recurved, posterior row almost straight, very slightly procurved. All eyes except anterior medians ringed with black. Measurements of eyes: Diameter of A.M.E., 0.20 mm.; P.M.E, 0 14 mm.; A.L.E., 0.11 mm; P.L.E., 0.16 mm. Distance between A.M.E., 0.15 mm.; P.M.E., 0.16 mm.; P.M.E. to A.M.E., 0.16 mm.; A.M.E. to A.L.E.,

EXPLANATION OF PLATE I

FIGS 1–8. *Allepeira lemniscata* (Walckenaer). Female, Onion Creek, Travis Co, Texas. Fig. 1. Lateral view of body, × 7.5 Fig. 2. String of egg-sacs, × 1 Fig. 3 Anterior part of carapace, showing eyes, × 23. Fig 4 Maxillae, lip, and sternum, × 20. Fig. 5. Spinnerets, colulus, and anal tubercle, × 20. Fig. 6. Chelicerae, × 30. Fig 7. Female genitalia, ventral view, × 60 ATR, atriolum. Fig. 8. Female genitalia, postero-ventral view, × 60. ATR, atriolum; AT, atrium; AW, anterior atrial wall, P, parmula.



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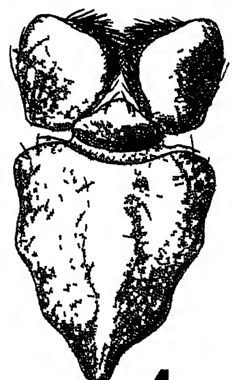

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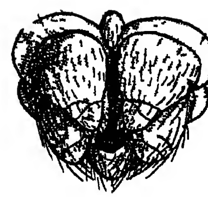

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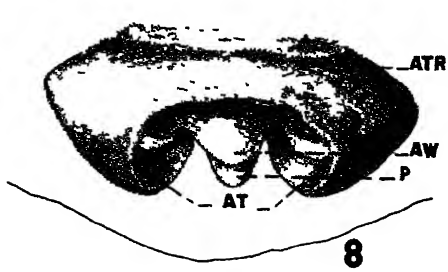

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0.12 mm.; P.M.E. to P.L.E., 0.14 mm. Lateral eyes not touching but very close together. Clypeus, 0.06 mm. high, receding.

Chelicera robust at base, slightly geniculate at base, with a fairly well developed boss; boss much more conspicuous in some specimens than others, usually similar in color to rest of chelicera. Fang groove with 4 teeth on anterior margin, one on posterior margin. Maxillae short, almost meeting over lip, median edges scopulate. Lip broader than long, strongly rebordered. Sternum cordate, lateral edges smooth, ending posteriorly in blunt point in front of hind coxae.

Palp long, spiny, ending in a long claw armed with a comb of five teeth.

Legs 1, 2, 4, 3, clothed with longitudinal patches of short, fine hair, and armed with numerous long, slender spines that stand at a 60 degree angle with segments (for enumeration of spines see page 318). Trichobothria on tibiae short, irregularly arranged in two rows on basal half of segment; one on each metatarsus. Three claws, upper two longer than third (when removed and measured; about equal in length as seen on tip of tarsus); two pairs of auxiliary claws. Upper claws armed with

TABLE I

FEMALE. LEG MEASUREMENTS IN MILLIMETERS

	Femur	Patella-Tibia	Metatarsus	Tarsus	Total
Palp	0.82	0.36 0.46	....	1.09	2.73
1	3.64	3.68	3.41	1.23	11.96
2	3.37	3.28	3.09	1.13	10.87
3	2.18	2.00	1.73	0.91	6.82
4	3.00	3.19	3.09	1.05	10.33

a heavy comb of 5 to 8 teeth, closely graded from basal (smallest) to distal (longest). Third claw unarmed except for basal nodule; quite geniculate. No tarsal drum.

Analysis of leg measurements shows the combined length of tarsus and metatarsus to be appreciably longer, on all legs, than the combined length of patella and tibia.

Abdomen elongate, cylindrical, with a pair of small, anterior, dorsal humps, which are sometimes inconspicuous, especially on older individuals; posterior tip of abdomen elevated and slightly prolonged beyond and behind spinnerets. Area of book-lungs smooth, with two to three inconspicuous furrows. Only a few structures of the genitalia are visible from the ventral surface (figs. 7, 8). Tracheal spiracle directly anterior to colulus. Colulus large and conspicuous. Six spinnerets close together; anterior pair a little the heaviest, median pair very slender, posterior pair slightly longest. Anterior and posterior spinnerets bear small terminal joints. Anal tubercle directly behind spinnerets.

Male.—Total length, 5.70 mm. (hypotype male about average for the Austin population, where males vary from about 5 to 6.5 mm. in length; a male from Cuba is 8.1 mm. long); length of carapace, 2.63 mm.; width of carapace, 1.91 mm.; height of carapace, 0.55 mm.

Color, pattern, and general shape as in female; head part a little narrower and more rounded in front; without humps on abdomen; legs longer in proportion to length of body.

Eyes as in female, but laterals a little farther apart. Diameter of A.M.E., 0.18 mm.; P.M.E., 0.16 mm.; A.L.E., 0.10 mm.; P.L.E., 0.14 mm. Distance between A.M.E., 0.12 mm.; P.M.E., 0.14 mm.; A.M.E. and P.M.E., 0.18 mm.; A.M.E. and A.L.E., 0.09 mm.; A.L.E. and P.L.E., 0.03 mm.; P.M.E. and P.L.E., 0.14 mm. Clypeus, 0.06 mm. high.

Chelicerae, maxillae, lip, and sternum as in female.

Palp short; femur somewhat curved, without true spines; patella with an inconspicuous basal spine, and a long, distal, dorsal, bristle-like spine; tibia almost triangular in cross-section, without spines; cymbium with several long, spine-like bristles, and a basal hooked apophysis (vestigial paracymbium). (See figs. 9–11 for details of bulb.)

Legs with long, slender spines as in female (see detailed account of spines); claws and trichobothria as in female; color as in female. Legs

TABLE II

MALE. LENGTH OF LEGS IN MILLIMETERS

	Femur	Patella-Tibia	Metatarsus	Tarsus	Total
Palp	0.64	0.36 0.23	....	0.64	1.87
1	4.05	4.37	4.19	1.46	14.07
2	3.82	3.91	3.73	1.27	12.73
3	2.45	2.09	1.96	0.91	7.41
4	3.73	3.46	3.64	1.09	11.92

of male longer in proportion to length of cephalothorax (about 5 to 1), than in the female (almost 4 to 1).

Abdomen has same pattern as on female, slightly more slender and lacking humps on anterior part of dorsum; book-lungs, tracheal spiracle, colulus, and spinnerets similar.

GENITALIA OF ALLEPEIRA LEMNISCATA

Structures of the secondary sexual organs are homologized as closely as possible with those of *Epeira dumetorum* Hahn (Comstock, 1910, as *Aranea ocellata* (Simon)), *Agalena naevia* (Walckenaer) (Petrunkevitch, 1925), and species of *Linyphia* Latreille (Blauvelt, 1936).

In general the terminology of Comstock, Petrunkevitch, and Blauvelt has been used. The term "epigynum" is applied to the female organs by most arachnologists. As Petrunkevitch (1925, p. 564) pointed out, however, "epigynum" correctly has a far more restricted meaning. He used "external reproductive organs of the female" which is cumbersome and misleading, inasmuch as most of the organs are internal. "Female genitalia," although a very general term, has the advantage of being intelligible to zoologists. It applies to all spiders, whether or not there are externally visible parts. In current descriptions of female spiders, far too much emphasis has been placed on the appearance of

the externally visible genitalia, which changes with age, amount of chitinization, and, often, exudation. The terms "seminal receptacle" and "spermetheca," usually regarded as synonymous, are used here for the analogous structures in male and female respectively.

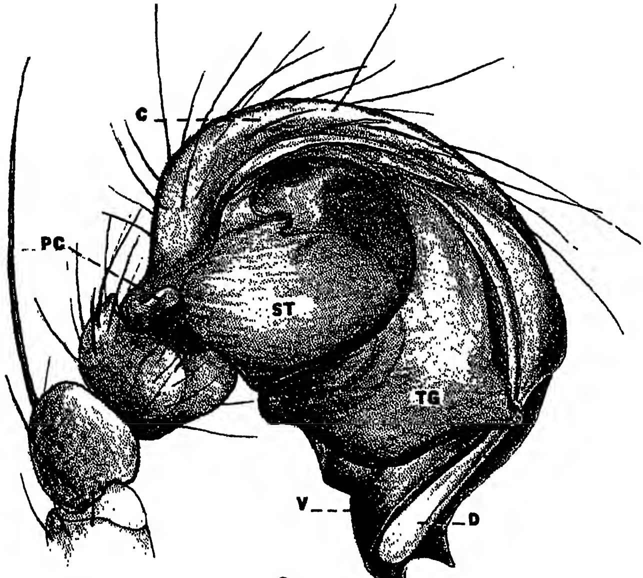
Female.—The female genitalia are quite highly developed. The atriolum (figs. 7, 8, 12) is black or deep brown, and heavily chitinized, protruding ventrally. The atrium (fig. 8) is postero-ventral; the atrio-bursal openings are lateral; the high triangular anterior wall of the atrium is slightly chitinized and glabrous. Posterior to the atrial wall is a small, lightly chitinized lip, which appears to be homologous with the parmula of *Linyphia*. Internally, the structures of the right and left halves of the genitalia are completely separate. The openings on each side of the atrium lead into a flat, membranous bursa which extends antero-dorsally, ending in a blind pouch; medially the bursa connects by a slit-like opening into the heavily chitinized spermatheca. Each spermatheca is a compound structure of two dumb-bell shaped parts with a common canal, lying almost at right angles to one another. Near their union and the opening from the bursa, the fertilization duct drains the dorsal lobe of the spermatheca laterally, and runs dorsally to the ventral wall of the vagina. (See figs. 12, 13.)

Male.—The palp is short, with very short patella and tibia; the bulb of the cymbium is large (fig. 9). The cymbium is spoon-shaped, covered on its dorsal surface with spine-like bristles. Ventrally it is hollow, containing the structures of the bulb. The bulb is attached to the alveolus of the cymbium by a large, basal haematodocha, followed by a flattened sclerite (the subtegulum), which incloses and protects the seminal receptacle (fig. 10). The latter connects directly with the median division of the bulb by a seminal duct with chitinous walls. No median haematodocha is present. The median division consists of a large, cone-shaped, highly chitinized tegulum, the largest sclerite of the bulb; within it, the seminal duct makes one and one-half large, irregular spirals; laterally, the tegulum bears a blunt, unarticulated process, homologous to the median apophysis. Between the tegulum and the apical division of the bulb, apparently is a small, distal haematodocha, and a small finger-like conductor. The conductor is not highly chitinized, and is difficult to see in most positions, being hidden by the tegulum below and the apical division above. The seminal duct passes from the tegulum to the apical division, surrounded by a membranous

EXPLANATION OF PLATE II

FIGS. 9–11. *Allepeira lemniscata* (Walckenaer). Male, Onion Creek, Travis Co., Texas. Fig. 9. Right palp, ventral view, × 50. PC, paracymbium; C, cymbium; ST, subtegulum; TG, tegulum; V, ventral arm of terminal apophysis; D, dorsal arm of terminal apophysis. Fig. 10. Right palp (*expanded*), prolateral view, × 25. T, tibia; PA, patella; H, basal haematodocha; ST, subtegulum; TG, tegulum; M, median apophysis; CN, conductor; E, embolus; A, terminal apophysis. Fig. 11. Right palp (*expanded*), ventral view, × 20.

FIGS. 12–13. Females, Onion Creek, Travis Co., Texas, genitalia (*cleared*), × 60. Fig. 12, Dorsal view. ATR, outline of atriolum; B, bursa; S, spermatheca; F, fertilization duct; AA, anterior wall of atrium and parmula. Fig. 13. Postero-dorsal view.



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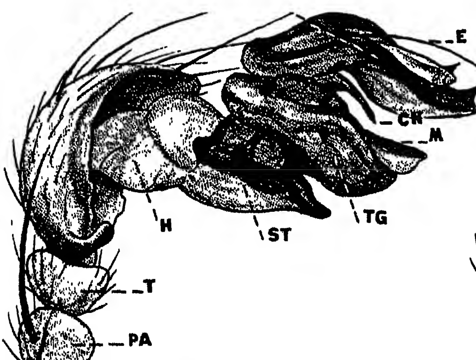

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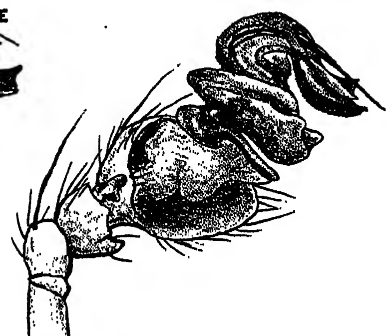

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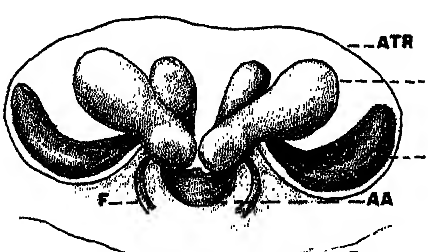

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or lightly chitinized sheath. The apical division consists of this sheath, the chitinous embolus, and the terminal apophysis The embolus surrounds, or forms the wall of, the seminal duct as it emerges freely from the sheath and the terminal apophysis The terminal apophysis arises as an anterior chitinization of the sheath, and lies across the entire anterior portion of the bulb. A short distance from its point of origin, the terminal apophysis divides into two processes, the larger posterior arm, and a ventral membranous arm. The posterior arm of the terminal apophysis is large, somewhat spoon-shaped, heavily chitinized, and bears a large tooth on its anterior edge. Where the two arms of the terminal apophysis separate, the embolus emerges from the sheath, lying free in a ventral groove along the anterior margin of the dorsal arm, and is somewhat covered by the ventral arm

In mating, the posterior arm of the terminal apophysis probably is inserted up to its tooth into the bursal cavity of the female, accompanying the embolus. The anterior tooth engages the edge of the atriolum, preventing the chitinous posterior arm from puncturing the membranous bursa. In *Argiope aurantia* (Lucas), the entire terminal apophysis has been observed to be inserted into the bursa. In the latter case, however, the bursa is very large and heavily chitinized.

ANALYSIS OF LEG SPINATION

Spination of the legs has long been used as a generic and specific character, especially in the Lycosidae, Clubionidae, and Salticidae. In general, only the ventral spines on the tibia and metatarsus of leg 1 have been used, although dorsal, prolateral, and retrolateral spines usually are present. Seldom have the leg spines been enumerated completely, nor has their variability been established

Leg spines are subject to considerable variation within a species, comparable to the appreciable variability in number of teeth bordering the furrow of the chelicera—which also has been employed uncritically as a systematic character. Differentiating spines, bristles, and hairs also presents a problem in discrimination. Spines well developed in one individual may be very small on another, or replaced by bristles. Frequently one cannot distinguish long, slender spines from stout bristles, as in *A. lemniscata*. Some systematists might consider the ventral armature of the femora as bristles, whereas in this study they are regarded as spines.

The spines of the legs of *Allepeira lemniscata* are as follows:

Spines of female hypotype.—Leg 1. Femur. dorsal, 4 (short, bristle-like); prolateral, 3 (short); retrolateral, 4 (short); ventral, 5 pairs plus 2 proximal (in series on posterior side) and 2 interspersed posteriorly among pairs (all long, bristle-like). Patella: dorsal, 2 (1 distal); prolateral, 1; retrolateral, 1. Tibia: dorsal, 3; prolateral, 2; retrolateral, 3; ventral, 4 pairs. Metatarsus: dorsal, 2; prolateral, 3; retrolateral, 2; ventral, 2 pairs plus 2.

EXPLANATION OF PLATE III

FIG. 14. *Allepeira lemniscata* (Walckenaer). Web of female. Onion Creek, Travis Co., Texas; July, 1947. About one-third natural size.

Leg 2.—Femur: dorsal, 4 (short); prolateral, 3; retrolateral, 4 (small); ventral, 6 pairs (bristle-like). Patella: dorsal, 2 (1 distal); prolateral, 1; retrolateral, 1. Tibia: dorsal, 3; prolateral, 3; retrolateral, 3; ventral, 3 pairs. Metatarsus: dorsal, 3; prolateral, 1 (basal); retrolateral, 2; ventral, 4 pairs (staggered).

Leg 3.—Femur: dorsal, 3 (weak); prolateral, 1 (distal); retrolateral, 3 (very weak); ventral, 4 anterior (sinuous, bristle-like, long) and 3 posterior (very weak, bristle-like). Patella: dorsal, 2; prolateral, 1. Tibia: dorsal, 2; prolateral, 1; retrolateral, 1 pair (basal) and 1; ventral, 2 pairs. Metatarsus: dorsal, 3; prolateral, 1 (basal); retrolateral, 2; ventral, 3.

Leg 4.—Femur: dorsal, 4 (weak); prolateral, 1 (distal); retrolateral, 1 (distal); ventral, 1 (basal, bristle-like). Patella: dorsal, 2; prolateral, 1. Tibia: dorsal, 2; prolateral, 1; retrolateral, 2; ventral, 1 pair (basal) and 1. Metatarsus: dorsal, 2; prolateral, 3; retrolateral, 4; ventral, 1 pair and 1.

Spines of male hypotype.—Leg 1.—Femur: dorsal, 4; prolateral, 4; retrolateral, 4; ventral, roughly 5 pairs plus 1 (posterior, bristle-like). Patella: dorsal, 2 (1 distal); prolateral, 2 (1 basal); retrolateral, 1. Tibia: dorsal, 3; prolateral, 5; retrolateral, 4; ventral, 3 pairs plus 1. Metatarsus: dorsal, 2; prolateral, 2; retrolateral, 2; ventral, 3 pairs.

Leg. 2.—Femur: dorsal, 3; prolateral, 3 (small); retrolateral, 2; ventral, 5 pairs (bristle-like). Patella: dorsal, 2; prolateral, 1; retrolateral, 1. Tibia: dorsal, 3; prolateral, 3; retrolateral, 3; ventral, 3 pairs. Metatarsus: dorsal, 2; prolateral, 2; retrolateral, 2; ventral 3 pairs (staggered).

Leg 3.—Femur: dorsal, 3; prolateral, 3; retrolateral, 3; ventral, 2 posterior, 1 anterior. Patella: dorsal, 2; prolateral, 1; retrolateral, 1. Tibia: dorsal, 2; prolateral, 3; retrolateral, 2; ventral, 2 pairs. Metatarsus: dorsal, 3; prolateral, 3; retrolateral, 2; ventral, 2 pairs.

Leg 4.—Femur: dorsal, 5; prolateral, 3 (small); retrolateral, 0; ventral, 6 (all posterior). Patella: dorsal, 2; prolateral, 1; retrolateral, 1. Tibia: dorsal, 3; prolateral, 3; retrolateral, 3; ventral, 2 pairs. Metatarsus: dorsal, 2; prolateral, 4; retrolateral, 3; ventral, 3 plus about 4 (small, in series distally).

Table III shows (1) no consistent difference in spination between males and females, (2) a considerable variation between individuals, and (3) no greater variation between the specimens from Cuba and those from Texas, than the latter do from one another, except in the possession of one extra dorsal spine on metatarsus 1. The demonstrated variability in spination of leg 1 indicates strongly the need for caution in using that character as a means of separating genera and species.

HABITS OF ALLEPEIRA LEMNISCATA

McCook (1878) described the web of *Allepeira lemniscata* (as *Epeira basilica*), and emphasized its dissimilarity to those of other argiopids and its apparent similarity to webs of certain linyphiids. He compared the web structure with that of argiopids which build typical orb-webs with subsidiary irregular structures, namely, *Leucauge venusta* (Walckenaer) (as *Epeira hortorum* Hentz) amd *Aranea pegnia* (Walckenaer)

(as *Epeira globosa* Keyserling). Later (1889–1893), he added Marx's notes on the building of the web, and described the egg-sac.

The web of *A. lemniscata* is made of very fine silk and is conspicuous only in sunlight, when the regularity of the orb structure is emphasized

TABLE III

SPINES OF LEG 1 ON 12 SPECIMENS OF *A. lemniscata*

	FEMUR				PATELLA				TIBIA				METATARSUS			
	Dorsal	Prolateral	Ventral	Retrolateral	Dorsal	Prolateral	Ventral	Retrolateral	Dorsal	Prolateral	Ventral	Retrolateral	Dorsal	Prolateral	Ventral	Retrolateral
♀ Hypotype	4	3	5 prs. + 4	4	2	1	0	1	3	2	4 prs.	3	2	3	2 prs. + 2	2
♀ N. Austin July 22, '47	3	3	3 prs + 4	3 + 2 s	2	1	0	1	3	3	3 prs. + 1	2	2	2	3 prs.	2
♀ Onion Cr. June 26, '47	4	4	5 prs + 1	3 + 3 v	2	1	0	1	3	2	3 prs. + 1	2	2	2	3 prs. + 1	2
♀ Onion Cr. June 20, '47	3	3	2 prs + 3	2	1	1	0	1	3	3	3 prs.	3	2	2	3 prs. + 1	2
♀ Cuba (M. C. Z.)	4	5	4 prs + 3	4	2	2	0	1	3	4	5 prs + 1	4	3	2	4 prs	2
♀ Onion Cr. May 17, '47 (Penult.)	3	2	2 6B	1	2	0	0	1?	2	2	3 prs.	1	2	1	2 prs. + 1	0
♂ Hypotype	4	4	4 prs. + 3	4	2	2	0	1	3	5	3 prs. + 1	4	2	2	3 prs.	2
♂ Onion Cr. June 20, '47	4	5	4 prs. + 4	3 + 5 vs	2	2	0	1	3	4	3 prs. + 2	3	2	2	3 prs. + 1	2
♂ Onion Cr. June 26, '47	4	3	4 prs. + 3	4 + 1 s	2	2	0	1	3	3	3 prs. + 1	3	2	2	3 prs. + 1	2
♂ Austin June 22, '47	4	4	6 prs. + 3	4 + 2 vs	2	1	0	1	4	3	4 prs. + 1	4	2	3	3 prs. + 1	2
♂ Cuba (M. C. Z.)	3	4	5 prs. + 4	4	2	1	0	2	3	3	3 prs. + 2	4	3	4	3 prs. + 1	3
♂ Onion Cr. May 11, '47 (Penult.)	3	3	6 7B	3	2	0	0	0	2	2	3 prs. + 2	0	2	2	4 prs.	2

B—bristle; pr—pair; v—ventral; s—very small.

by the iridescence of the fabric. It is essentially horizontal, exceedingly closely woven, and drawn into a dome by an irregular mass of threads above and below. The dome is about 20 cm. in diameter, and the mass

of attaching threads above the dome is higher than the diameter of the orb. The irregular mass below the orb is usually shorter than the diameter. McCook described a "curtain" or web-platform beneath the domed web, which was not found in the webs examined during the present study.

Marx (in McCook, 1889) observed that the orb-web is constructed first as a horizontal, flat, argiopid orb. The periphery then is drawn downward by many attachments, connecting the edge with shrubbery below, forming the lower mass of irregular threads. The upper side of the orb is elevated next, the central part being pulled upward by long threads from the upper surface to the shrubbery above. The completed orb is a perfectly domed structure.

Observations on the structure of the orb-web are difficult to make because the silk is very fine and the web itself is closely woven. McCook estimated that there are approximately twenty radii. The present study, however, shows that there are two hundred or more, both from observation and by computation.

The center of the orb is rather consistent in pattern for most argiopid species, and is often strengthened by special threads of heavier silk. It is remarkably inconspicuous in webs of *A. lemniscata*, however, and is not always the same. The silk of the spirals appears to approach the hub, which is about equal in diameter to the body length of the spider. A few delicate threads cross the open hub rather haphazardly. The manner of attachment of the radii in the central part, and their mode of stabilization, could not be ascertained by field observations. The mesh, one to two millimeters, appears to be the same size at the hub and periphery. Therefore, not all of the outer radii can extend to the center of the web.

McCook suggested that the orb of *A. lemniscata* is made of inelastic silk, like that of the notched zone of other argiopid webs, not of viscid silk used for the spiral thread by most members of the family. Observations on this point have not been conclusive, but the web feels viscid to the touch. The woof of the web appears quite homogeneous from hub to periphery, and the attachments on the radii appear somewhat notched, as noted by McCook.

Males and females, in penultimate or pre-penultimate moult stages, were found living together in typical domed orbs (May, 1947, near Austin, Texas). Each female was accompanied by from one to three males. The webs were built by the females, as evidenced by their tenancy of central positions under the domes; the males had in each case situated themselves a few inches distant. Tenants of a web run in divergent directions to the periphery when disturbed, with quick, jerky movements. When sufficiently alarmed, all seek shelter in the adjacent shrubs. This habit is at variance with the common argiopid reaction of dropping from the web.

Archer (1940, p. 24) stated that young individuals build only a linyphiid type web until near maturity. My observations indicate, further, that males of *A. lemniscata* probably never build orb-webs. Two males approaching maturity, placed in large jars in the laboratory, constructed only extensive sheet webs. Moreover, males live continuously in webs made by females for a period of about six weeks,

from at least the penultimate instar stage until they disappear, about the time that the female weaves her first egg-sacs.

The string of egg-sacs is placed in the middle of the mass of irregular lines above the hub of the orb, and is supported by a heavy strand of silk anchored to twigs on each side (figs. 2, 14). The first egg-sac is globular and is suspended from the supporting strand by many adherent threads. It is about six millimeters in diameter, and gray, with brown showing through the outer threads. A few days after the first batch of eggs has been laid, a second egg-sac is added below the first, slightly overlapping it. The completed string of egg-sacs may include as many as nine, although usually from three to five. Typically in a linear series, one or more may be offset. The female disappears shortly after the string of egg-sacs has been completed, and the web soon vanishes. The egg-sacs and the strands supporting them, however, persist long after the disappearance of spider and web, and have been observed during winter months.

Some egg-sacs examined during August contained spiderlings, but others had been parasitized. Sometimes the later one or two egg-sacs of a string are empty. Each egg-sac is an elaborate structure, similar in construction to the single and much larger sac of *Argiope aurantia*. A mass of about twenty yellow eggs is first covered with a thin layer of downy silk. This is closely surrounded by a brown, fibrous covering, waterproof and very tough. A thin, grayish white silk matting, over the brown fibrous layer, almost conceals the color. Rarely, after the egg-sacs have been completed, a soft, white, cottony mass of silk is woven over the entire string, giving the aggregate the appearance of a loose mass of cotton wool.

Field observations show a striking resemblance between *Allepeira lemniscata* and the American dome weaving linyphiids, *Linyphia litigiosa* Keyserling and *L. marginata* C. Koch. The general form of the web is almost the same, except that the dome is not as high. They agree as well in body shape, similarity in size and structure of male and female, long period of association of males and female, and type of movement when disturbed. These peculiarly linyphiid habits and forms, in an argiopid spider, probably are an adaptation to life under a closely woven dome-shaped web. The fundamental difference of habit involved in building an orb-web, as opposed to sheet-web construction, implies that the similarity is superficial and not indicative of close relationship.

Subfamily **Allepeirinae** Exline, new subfamily

The morphological characters of *Allepeira*, in conjunction with the habits observed for *A. lemniscata*, are the basis for proposal of the subfamily Allepeirinae within the family Argiopidae.

Diagnosis.—Posterior eye row nearly straight with eyes about equidistant; boss present on chelicera; no trichobothria on femora; maxillae nearly square; chitin over book-lungs not conspicuously furrowed; spiracular furrow near spinnerets. Male not appreciably smaller than female, and having no specialized secondary sexual char-

acters other than of the palp. Male palp with short patella and tibia; cymbium with basal apophysis (vestigial paracymbium). Female genitalia with well chitinized atriolum, atrial openings leading into bursae.

The subfamily comprises spiders building a domed orb-web, and laying a string of several egg-sacs. Males live in web of female as they approach maturity, probably never constructing orbs.

Relationships within the family.—The subfamily Allepeirinae is placed between the Metinae and the Argiopinae. It agrees with the Metinae in eye arrangement and the slightly furrowed chitin over the book-lungs. The proportions of the leg segments are different, the genitalia are more highly specialized, and the boss of the chelicera is more pronounced. In these characters, the Allepeirinae agree with the Arigiopinae, but differ in eye arrangement and in the slight furrowing of chitin over the book-lungs. Separation from the Tetragnathinae is demanded on several counts: the simplicity of genitalia in the latter, absence of cheliceral boss, presence of femoral trichobothria, and peculiar development of chelicerae and maxillae. Separation from the Araneinae is shown by the different proportion of leg segments in that subfamily, with stout spines, great sexual dimorphism, median eyes remote from lateral eyes, and the conspicuous furrows on the book-lungs. Other subfamilies of the Argiopidae (Theridiosomatinae, Nephilinae, and Gasteracanthinae) obviously are not closely related to the Allepeirinae.

Because some of the habits of *Allepeira lemniscata* are so similar to those of *Linyphia*, it is tempting to consider the Allepeirinae a link between the families Argiopidae and Linyphiidae, as suggested by McCook (1889). This inference is untenable on morphological grounds, and questionable from the standpoint of evolution: it would derive a highly specialized argiopid from a highly specialized linyphiid ancestor. It seems more reasonable to believe that the construction of a dome web, by *Linyphia* and *A. lemniscata*, is a convergence of habit that has arisen independently in the two groups. Ancestors common to both families were very much more primitive organisms, and probably have been long extinct.

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THE INSECT GUIDE, by RALPH B. SWAIN. Doubleday and Company, Inc., Garden City, New York. xxxix+261 pages, 15 black and white and 48 colored plates. 1948. Price, $3.00.

This excellent manual, written with a minimum of technical terminology, should prove very useful to amateur entomologists, high school teachers and students, and professional workers alike. Though simply written, it is authoritative. Dr. Swain, himself a well-trained entomologist, has attempted to eliminate errors so far as possible by submitting all parts of the manuscript, including illustrations, to specialists in the respective fields.

The book is prefaced by a section defining an insect and giving the essentials of insect anatomy, together with miscellaneous useful information. The body of the work is devoted to characterizations of the orders and principal families, with some information concerning life histories and economic importance, and with examples. Though popular names are given the prominent places throughout, scientific names are added for reference. The terminology of scientific names is that currently adopted by the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture. The closing pages give directions for collecting and preserving insects, some more important references, and an index.

Much credit should go to the illustrator, the author's wife, SuZan N. Swain. The 175 families discussed are all illustrated at least once, and to make reference easy, the illustrations bear the same numbers as the corresponding families in the text. The accuracy in delineation and coloration and the artistry of the illustrator is highly commendable.

There are no keys. The inside covers, however, show in tabular form the most important characteristics of the orders. This, together with reference to the illustrations, is designed to aid the student in making identifications.—M. T. J.

A NOTE ON THE NESTING HABITS OF THE WASP, PEMPHREDON INORNATUS SAY

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Two nests of the aphid-hunting wasp, *Pemphredon inornatus* Say[1] were found close together in the hollow, woody stems of a pink flowering Weigelia in my garden on June 10, 1945. Both nests belonged to one mother. When I came upon her, I found that she had completely filled one of the stems with cells and young, and while still holding the vestibule at the opening for her own home, had commenced to nidify in the other hollow stem near by.

The young in the completed stem showed progressively greater stages of development from the top to the bottom. The two most recently built cells at the top contained larvae which evidently had only recently completed feeding; the central cells had quiescent larvae of various stages grading into pupae, while the lowermost two cells had full-grown pupae with pigmented eyes. All of this could easily be seen when the twig was split open.

The fact that the top two cells had larvae that had finished feeding, rather than eggs or young larvae, indicates conclusively that the vestibule had been kept open for the purpose of accomodating the mother.

There were 18 cells in the nest, the larger ones at the bottom and the smaller ones on top, as so often happens with Hymenoptera which regulate the sex of the progeny. The size of the cells, in sixteenths of an inch, in order from the bottom upward, were as follows: 6, 6, 6, 6, 4, 6, 4, 5, 6, 5, 5, 4, 4, 4, 4, 4, 4, 4. With only very few exceptions, the smaller cells were at the top and the larger ones at the bottom; theoretically this means that female eggs in larger cells are deposited first, and male eggs in smaller cells later. But unfortunately, no record was kept to determine which sex emerged from the respective cells. From June 16 to 20, ten adults emerged.

The larvae in this stem had all finished feeding when the nest was taken, and there was no food in the cells, but from the second stem, already mentioned, then early in the course of nest construction, there were two cells and these were filled with aphids, which were later identified by Mr. P. W. Mason as *Aphis gossypii* Glover.

[1]Kindly identified by Dr. K. V. Kronbein.

RECOVERY OF ANOPHELINE EGGS FROM NATURAL HABITATS, AN AID TO RAPID SURVEY WORK[1]

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Experience gained during the course of an anopheline survey of the island of Sardinia in the summer (May-August) of 1946 demonstrated the value of anopheline egg collections under natural conditions. Recourse was had to this method because limited time made it necessary to conduct the survey as rapidly as possible. Sardinia comprises a land area of roughly 9,300 square miles and a good seven tenths of it lies at 500 meters or higher. The Island has a population of about 1,222,000 inhabitants, of which approximately 93 per cent live in the village centers. Rural habitations are rare except in a few localities, so that man-made shelters for house-haunting species of anophelines are few and far between, and even non-existent in certain regions. Prior to the survey, it was known that at least two members of the *Anopheles maculipennis* group had been reported from the Island, and inasmuch as these species are only readily classified in the egg stage it was necessary to have eggs in order to make the survey complete.

Heretofore, a member of the *maculipennis* group usually has been demonstrated in a locality by collecting adult females and allowing them to lay eggs. This is generally an unsatisfactory method, as it means waiting from one to several days for the oviposition, providing the female does not die in the meantime. Moreover, if a widespread survey is being made and the base of operations is constantly moved around the countryside, only a small number of females can be collected from any one locality because of limited travel space in the vehicle; frequently under such conditions mortality rates are high. In sparsely populated areas, of which there are many in Sardinia, adult anophelines are extremely difficult to find. One can search for them under bridges, overhanging stream banks, grottoes, etc., but the returns usually are very small. Night collections also can be made, but in rapid survey work only a small portion of the countryside can be sampled in this way.

Because of these difficulties, the writer investigated the possibility of searching for anopheline eggs in natural habitats. Preliminary observations had been made along this line by the writer in Corsica during the summer of 1944. This is by no means a new idea. Both Barber (1935) and Bates (1941) have resorted to this technique, but it appears to have received scant attention from most field workers. The former devised a white mitten of loose cloth which covered the hand and through which water collected in a dipper from a potential breeding place could be drained, leaving any eggs present stranded on the cloth.

[1]The studies and observations on which this paper is based were conducted with the support and under the auspices of the International Health Division of The Rockefeller Foundation with the cooperation of the Alto Commissariato per l'Igiene e la Sanità Pubblica of the Republic of Italy.

These were transferred to moist cotton in a vial by means of a blade of grass or dry twig and then studied in the laboratory. Bates followed essentially the same technique, except that he used an embroidery loop, holding a similar piece of loosely meshed cloth which had been marked off into squares to facilitate counting eggs.

The disadvantage of the cloth method is that floating debris (sticks, plant seeds and stems) and algae may clutter up the cloth under certain situations and make the search for eggs unnecessarily difficult. The writer noted that by carefully examining the water in a dipper sample from a potential breeding place, it was possible to see the eggs floating on the surface. Once the size, shape and colors of the eggs have been properly registered in the mind, they are, if present, quite readily separated from floating debris. After an egg is found, it is fished out with a piece of straw, or preferably, the dried spiky leaf of wire grass (*Eleocharis*). The egg is examined with a hand lens (20X is a satisfactory magnification to use), and a tentative identification made. Then the egg is placed on a narrow strip of blotting paper soaked in 2 per cent formalin and stored in a small glass vial. In our work, these vials (6 cm. x 1.7 cm., with screw caps) are prepared in advance and each inspector carries a good supply with him. Each vial contains a small strip of blotting paper, cut slightly longer than the length of the vial. The extra bit of paper is bent, so that when it is placed in the vial, the strip lies along one side of the vial and cannot flip over thus to permit eggs to adhere to the glass and become damaged. A small amount of formalin is always kept in the vials before use in order to insure that the blotting paper will be well saturated; at the time eggs are collected the residue is poured off so that the eggs do not float away from the paper. The final identification of the species is made later in the laboratory.

The first attempts to locate eggs by the method described may result in failures, but once the eggs have been pointed out to the worker and he has become familiar with their size and color, he soon has little difficulty in finding them for himself. True, the eggs are very small, and the operation requires a person with good vision. However, the writer has had no difficulty in training his associates and inspectors in the technique. Egg collections are now routine in all of our survey work.

The advantages of egg collections are that not only can one make immediate specific identifications in the field when it may be impossible to do so with just the larvae, but one can also frequently survey an uninhabited area successfully where adult anophelines are difficult to find. The method was invaluable in obtaining a quick picture of the anopheline population in Sardinia. That the technique was satisfactory is attested by the fact that of 546 dipping stations containing the immature stages of some member of the maculipennis group, 442 or 81 per cent were positive for eggs and larvae, whereas only 104 (19 per cent) were positive for the larvae alone. Occasionally eggs were found in the absence of larvae (13 per cent of the total positive stations), or at times when Paris green had been dusted on the water and only first instar larvae were present. Our inspections were successful in recovering the eggs of *A. labranchiae*, *A. melanoon*, *A. claviger* and *A. algeriensis*.

The only species found in the absence of eggs was the uncommon hill-stream-inhabiting *A. marteri*. Species incidence, as determined in the original survey largely by the collection of eggs, was fully confirmed during the next season's studies when there was more opportunity to make other types of collections. We have found the eggs of *A. labranchiae* as early as March and as late as November.

After seeing the effectiveness of this technique in Sardinia, it seems highly probable that it could be used to advantage in other parts of the world. For instance, in South America, where the classification of *Nyssorhynchus* species frequently requires eggs for confirming an identification, collections of eggs in the breeding areas should be of great assistance. The *A. crucians* group in North America is another anopheline complex which might lend itself to this sort of a study. Likewise, the investigation of *A. pseudopunctipennis* and its many varieties could possibly be advanced very rapidly through similar inspections; because it is an inhabitant of algal mats the collections of eggs from such sources is very easy. If one gets down on one's hands and knees and examines an algal mat carefully, it is not at all uncommon to find numerous clusters of eggs (*A. labranchiae*) scattered over the surface of the mat. This type of macroscopic inspection is very handy in rocky stream beds where it is impossible to use a dipper.

As pointed out by Swellengrebel and de Buck (1938), however, one should be very careful how one interprets egg collections from natural sources. In the Netherlands it was demonstrated that both *A. atroparvus* and *A. messeae* ("shortwings" and "longwings" of those authors) eggs could be found abundantly in breeding places of low salinity, but the resulting larval population (fourth instar) was almost entirely that of *A. messeae*. On the other hand, in salt water breeding places, *A. atroparvus* maintained its dominance throughout. However, keeping the eccentric habits of females in mind, it is felt that one can increase the qualitative results of a survey considerably by giving careful attention to the search for eggs in the anopheline habitat.

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THE SUBGENUS NEOCULEX IN AMERICA NORTH OF MEXICO
(Diptera, Culicidae)

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Culex, subgenus *Neoculex* includes about twenty-five described species of mosquitoes from various sections of the world. They are distinguished by the following sum of characters: tarsi unbanded, scutal bristles strong and numerous, scales of vertex all narrow, male palpus without erect scale-like hairs on the "long" segment, male antennae without unusual processes, mesosome essentially of two lobes connected by a bridge about halfway between the base and apex. In the Nearctic species the male palpi are longer than the proboscis but in many exotic species the palpi are conspicuously shorter. The larvae are hardly separable on general characters from those of related subgenera, *Mochthogenes*, *Lophoceraomyia* and *Melanoconion.*

It has been assumed previously that *Neoculex* was represented in America north of Mexico by a single species, easily identified in the adult by the apical pale bands on the abdomen. While studying Californian specimens and comparing them with material from eastern United States it became apparent that several species were involved. Further collecting and examination of many specimens from other sections of the country revealed the presence of four well-marked species in the United States and a fifth in Mexico and Central America.

Entomologists and institutions who have furnished material for study are Alan Stone (U. S. National Museum collection), E. S. Ross (California Academy of Sciences collection), R. H. Beamer (University of Kansas collection), H. D. Pratt, J. Laffoon, B. Brookman, P. Galindo, W. Wirth, S. F. Bailey, Edgar A. Smith, B. T. Stevens, E. Seaman and R. H. Overbey.

Types of the new species have been deposited in the U.S. National Museum; paratypes have been distributed to the first eight individuals listed above, to Cornell University, and to the University of California.

Subgenus **Neoculex** Dyar

Neoculex Dyar, 1905. Proc. Ent. Soc. Wash., 7: 45. Type: *Culex territans*, by original designation.

Maillotia Theobald, 1907. A monograph of the Culicidae of the world, 4: 274. Type: *Maillotia pilifera* Theobald, by original designation. (Similar to *territans*, female only described; Algeria.)

Eumelanomyia Theobald, 1910. A monograph of the Culicidae of the world, 5: 114. Type: *Eumelanomyia inconspicuosa* Theobald, by original designation. (Male palpus about five-sixths as long as proboscis and sparsely haired, Ashanti, West Africa.)

Protomelanconion Theobald, 1910. A monograph of the Culicidae of the world, 5: 462. Type: *Protomelanconion fusca* Theobald, monobasic. (Male palpus about five-sixths as long as proboscis and sparsely haired, Ashanti, West Africa.)

KEY TO ADULTS OF NEARCTIC NEOCULEX

1. Antennae bushy, males 2
   Antennae not bushy, females 5
2. Terminal palpal segment with moderate to long hairs scattered along both sides as seen from above (figs. 5, 14) 3
   Terminal palpal segment without long hairs on outer side as seen from above, except sometimes one or two at base (figs. 10, 18) 4
3. "Long" segment of palpus with long hairs extending back from apex a distance nearly equal to length of terminal segment; mesosome lobes connected by a sclerotized bridge; dististyle with numerous microsetae and a row of membranous lobes (figs. 1–5) .... **territans**
   "Long" segment of palpus with long hairs extending back from apex a distance equal to about one-half length of terminal segment; mesosome lobes with a membranous connection; dististyle without numerous microsetae or membranous lobes (figs. 11–14) .... **apicalis**
4. Abdominal segments V and VI broader than long; terminal palpal segment without long hairs on either side as seen from above, except one or two at base; thoracic integument straw-colored to light brown; basistyle with an irregular row of short hairs along inner margin below subapical lobe (figs. 15–18) .... **reevesi**
   Abdominal segments V and VI longer than broad; terminal palpal segment with three or four long hairs on inner side as seen from above; thoracic integument dark; basistyle with a patch of long hairs on inner margin below subapical lobe (figs. 6–10) .... **arizonensis**
5. Palpus about twice as long as flagellar segment IV as seen in lateral view; ventral pale stripe of hind femur complete 6
   Palpus about three times as long as flagellar segment IV as seen in lateral view; ventral pale stripe of hind femur ending shortly before apex 7
6. Pale scales of vertex ashy white; abdominal segment V of unengorged dried specimens about 1.3 times as broad as long .... **territans**
   Pale scales of vertex with a yellowish tinge; abdominal segment V of unengorged, dried specimens 1.5 to 1.7 times as broad as long .... **reevesi**
7. Palpus usually with some pale scales at base of terminal segment and apex of subterminal one; upright forked scales of vertex pale to light brownish; scutal scales seldom in a sharply defined linear arrangement .... **apicalis**
   Palpus all dark; upright forked scales of vertex dark brown; scutal scales in a sharply defined linear arrangement .... **arizonensis**

KEY TO PUPAE OF NEARCTIC NEOCULEX

1. Submedian apical hair tuft of abdominal tergite II with about eleven strong straight branches from near base, tuft more than half as long as tergite III; lateroapical hair tuft of tergite VIII usually with six or seven branches .... **arizonensis**
   Submedian apical hair tuft of abdominal tergite II without strong straight branches or with fewer than eleven, tuft less than half as long as tergite III 2
2. Submedian apical hair of tergite II weak, with a long stem, generally with three and not more than five branches, about one-third as long as tergite III; lateroapical hair tuft of tergite VIII usually with one to three branches .... **reevesi**
   Submedian apical hair of tergite II stronger, with more than five branches, about two-fifths as long as tergite III; lateroapical tuft of tergite VIII usually with three to five branches 3
3. Submedian apical hair tuft of tergite II with about fifteen to twenty-five, flagellate branches .... **territans**
   Submedian apical tuft of tergite II with about seven to eight straight branches .... **apicalis**

KEY TO LARVAE OF NEARCTIC NEOCULEX

1. Upper and lower head hairs (C and B) usually double and equal in length and thickness; mesothoracic submedian hair (hair 1) about five branched and a little more than half as long as antenna; siphon apex about four-ninths basal siphon diameter; pecten teeth fringed at apex; most basal siphon hairs about three times basal diameter of siphon; siphon with a broad basal pigmented band (figs. 21, 22) .... **arizonensis**

Upper and lower head hairs not of equal length and usually not both double; mesothoracic submedian hair less than half as long as antenna; siphon apex usually not less than half basal diameter; pecten teeth simple at apex; siphon without a broad basal pigmented band........................ 2

2. Abdominal segments with lateral pigmentation spots on II, III, V and VI (visible on whole larvae only); upper head hair (C) usually double and about two-thirds as long as lower head hair (B) which is single; most basal siphon hairs enclosed by pecten and about twice basal siphon diameter (figs. 25, 26)..**reevesi**

Abdominal segments with an even distribution of pigment spots........... 3

3. Upper head hair (C) double or triple and about half as long as lower head hair (B) which is usually double; most basal siphon hairs not enclosed by pecten and about one-seventh as long as siphon; thorax densely pilose at 100 × magnification (figs. 23, 24)............................**apicalis**

Upper and lower head hairs (C and B) usually both single, upper about half to two-thirds as long as lower; most basal siphon hairs sometimes enclosed by pecten and one-sixth to one-third as long as siphon; thorax moderately spicular-pilose at 100 × magnification (figs. 19, 20)....**territans**

Culex (Neoculex) territans Walker

(Figures 1–5, 19, 20)

Culex territans Walker, 1856. Insecta Saundersiana, Dipt., 1: 428. Type: female, destroyed? (See systematics discussion below.)
Culex saxatilis Grossbeck, 1905. Canad. Ent., 37: 360. Type: female, U. S. N. M.
Culex frickii Ludlow, 1906. Canad. Ent., 38: 132. Type: female, U. S. N. M.
Culex apicalis Adams of Dyar and other authors, not of Adams.

Female.—Palpus about twice as long as flagellar segment IV seen in lateral view. Upright forked scales of vertex light brown to medium brown, curved scales ashy white. Thoracic integument usually a rather light brown, scutal scales generally coppery but sometimes with a paler discal spot or pale lines; hind femur with a complete pale ventral stripe. Apical abdominal bands broadened beneath into spots which often extend length of segment.

Male.—Palpus with long and dense hairing (fig. 5), long hairs at apex of "long" segment occupying a space nearly equal to length of terminal palpal segment, last two segments slightly more than half as long as proboscis. Thorax ground color usually a rather light brown, scutal scales mostly coppery and hair-like, sometimes paler but not shaggy. Dorsal abdominal bands tending to be triangular but sometimes becoming obsolete beginning at sides; segments V and VI longer than broad. Genitalia (figs. 1–4): mesosome lobes connected near middle by a sclerotized bridge; basistyle moderately constricted at middle, hairs along inner margin below subapical lobe fine and short; subapical lobe with two strong, apically hooked setae which are about equal in length, five other setae of which three most apical have fine, backward-pointing spines; dististyle with numerous short hairs and two longer ones on expanded apical portion, and a row of membranous lobes at base of this area (seen with careful focusing and high magnification), apical tooth moderate.

Larva (figs. 19, 20).—Antenna constricted at apical third, dark at base and beyond constriction, whitish between; head hairs (C and B) usually single but upper (C) sometimes double or triple and lower (B) rarely double, upper hair not more than three-fourths as long as lower. Mesothoracic submedian hair (hair 1) not more than one-third as long as antennal shaft, double to quadruple; thorax moderately spicular-

pilose at 100 X magnification. Submedian hairs of abdominal tergites I and II single or double and less than one-sixth antennal length; abdominal segments rather evenly pigmented. Siphon usually six to seven times its basal diameter, slightly inflated toward apex which is usually about two-thirds basal diameter; about ten scattered hairs, usually beyond pecten, basal ones usually pentad and one-fifth to one-third siphon length; pecten usually on basal one-third of tube, middle tooth usually tridentate. Lateral hair of anal segment very slender and double to quadruple, gills usually somewhat shorter than saddle, but ranging up to twice as long as saddle.

Pupa.—Submedian hair tuft at apex of abdominal tergite II with a short stem which branches and rebranches into fifteen to twenty fine flagellae; tuft about two-fifths as long as tergite III. Lateroapical hair tuft of tergite VIII with an average of 3.8 branches (84 tufts examined from Georgia, Iowa and Alaska: 5 double, 28 triple, 32 quadruple, 16 quintuple, 3 sextuple).

Distribution.—United States west to the Rockies, Oregon, Washington, Canada and Alaska.

Material examined[1].—About two hundred adults and numerous larvae and pupae from the following localities: VERMONT: Jacksonville. MASSACHUSETTS: Montgomery, Springfield, Wilbraham, Granby. NEW YORK: Hamburg, Buffalo. RHODE ISLAND: Kingston. MARYLAND: Plummer's Island, College Park, Pokomoke. VIRGINIA: Williamsburg.* NORTH CAROLINA: New River.* GEORGIA: Brick Pits (larvae), Vogal State Park (larvae and pupal skins), Moody Field. FLORIDA: Sanford, Ellyson,* Jacksonville, Rock Springs. MISSISSIPPI: Camp Shelby (larvae only). TEXAS: Blanco,* Luling,* New Braunfels,* San Antonio,* Brazos Co. LOUISIANA: Camp Livingston (larvae). OKLAHOMA: Stillwater.* MISSOURI: Camp Crowder. IOWA: Ames* (including pupal skins), Polk Co., Orange City (larvae), Dubuque. MICHIGAN: Cheboygan Co. MINNESOTA: Wabasha. MONTANA: Glacier Natl. Park. OREGON: Gold Hill. WASHINGTON: Hoodsport, Sumas. BRITISH COLUMBIA: Pitt Mesa, Kaslo. ALASKA: Anchorage* (including pupal skins), Fox,* Matanuska.

Biology.—Larvae have been found most often in permanent ponds, permanent and intermittent marshes, and in grassy creek pools. They have also been reported from borrow pits, ornamental fish ponds, creekbed potholes and evanescent rain pools. They do not favor foul water and are often taken in association with species of *Anopheles*. They may be collected the year around in southeastern United States (Michener, 1945), from early March to late November in Arkansas (Carpenter, 1941), from late January to October in North Carolina (personal records), from April to September in Iowa (Rowe, 1942), and from the middle of May to early October in New Jersey (Headlee, 1945). There are several to many generations a year, limited only by cold weather.

Smith (1904) and Headlee (1945) have suggested that in cold climates the winter is passed in the egg stage. This opinion is based on the

[1]Localities in this paper marked with an asterisk indicate that both larvae and adults have been examined. Otherwise, unless specified, only adults have been studied.

observations that egg boats disintegrate readily and sink, the eggs hatching under water; and on the lack of evidence that the female hibernates. Headlee (1945) reported the trapping of 3,394 females in New Jersey, none of which were hibernating. On the other hand, Howard, Dyar and Knab (1912) stated that the winter was passed by the female and cited the collection of females from rock crevices in March in the Washington, D.C. area as proof. I have seen three females collected hibernating in an unfinished dwelling at Gold Hill, Oregon, December 21, 1947 by B. T. Stevens.

Shannon (1915) first reported this species feeding on a frog. He collected females swarming about a bullfrog, *Rana catesbeiana*, in Virginia. Dyar (1928) gave the hosts as frogs and snakes. Matheson (1944) reported having yearly observed feeding on frogs. They have not been observed to attack man.

Systematics.—This species was called *territans* Walker in the earlier literature because the original description referred to apical abdominal bands and gave "United States" as the type locality. Theobald (1901) redescribed the female type, stating that the apical bands were "very indistinct in the specimen". He also cited "United States" as the locality. Edwards (1932) raised doubt as to the identity of *territans* in the following statement, "Walker's description of *C. territans* apparently indicates *C. apicalis* Adams, but the specimen in the British Museum labeled as the type is a flavescent abberation (female) of some species of the *salinarius*-group. It is possibly wrongly labeled, especially as it bears the label 'Vvr' (? = Vancouver) while the type was said to be from the United States". Considering Walker's and Theobald's definite statements as to the abdominal banding and type locality, with neither of which the supposed type agrees, it seems best to apply *territans* to the most common and widespread species of the *apicalis* group and to assume that the type has been lost. In addition to being the logical solution for the species, this makes it possible to retain the subgenus *Neoculex*, for which *territans* was cited as the type.

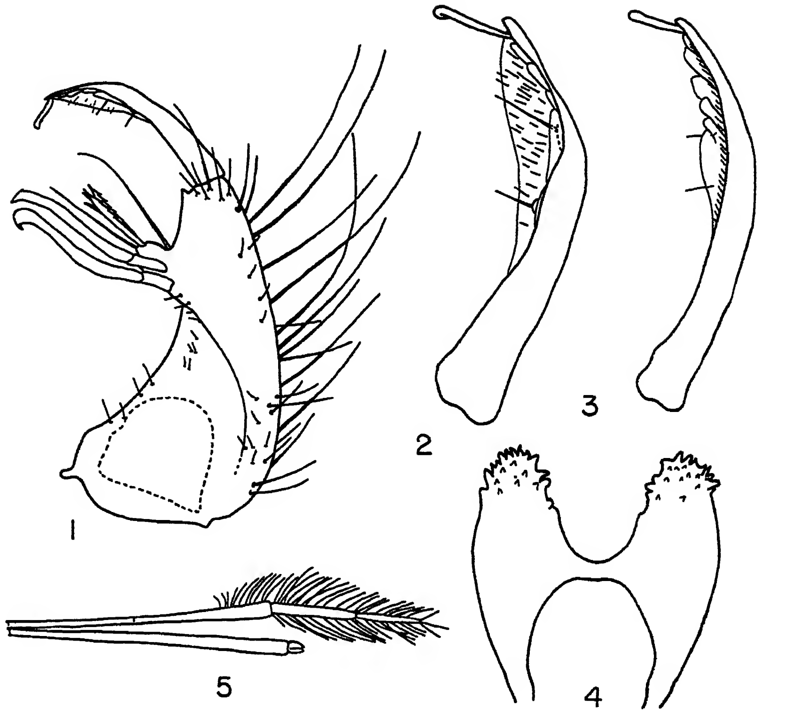
C. saxatilis was described from females reared from a rock-bottomed pool on Garrett Mt., New Jersey, and said to differ from *territans* by the "large size, dark colour, broadly banded abdomen and spotted thorax". The name *frickii* was based on females from Fort Snelling, Minnesota and said to differ from *territans* in "general coloration, in the 'frosty' submedian lines of the mesonotum, the light scales around the 'bare space', light scales on the scutellum, the much better developed apical abdominal bands, white bases and venter of femora, and the minute

EXPLANATION OF PLATE I

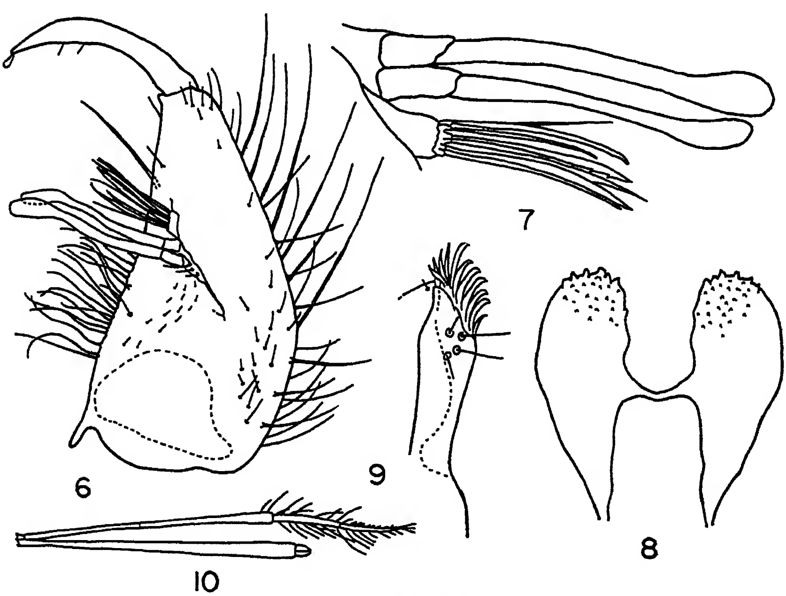
Male genitalic characters drawn with camera lucida in ventral view, sidepieces dissected and mounted separately; male mouthparts in dorsal view. Not drawn to scale. Figs. 1, 2 and 4, Montgomery, Massachusetts; fig. 3, Anchorage, Alaska. Fig. 5, Camp Crowder, Missouri. Figs. 6–10, Prescott, Arizona.

Figs. 1–5. *C. territans*. Fig. 1. Sidepiece. Fig. 2. Diststyle in ordinary view. Fig. 3. Diststyle in oblique view. Fig. 4. Mesosome. Fig. 5. Male palpus and proboscis.

Figs. 6–10. Paratypes of *C. arizonensis*. Fig. 6. Sidepiece. Fig. 7. Filaments of subapical lobe of basistyle. Fig. 8. Mesosome. Fig. 9. Paraproct. Fig. 10. Male palpus and proboscis.



Culex territans



Culex arizonensis

spot at apex of tibia". The spots and pale lines of the scutum in *territans* are subject to a great deal of variation, however, and both names appear to fall under *territans*. Theobald (1903) described *sergentii* from an Algerian female, and the description fits *territans* closely. The same can be said for *pyrenaicus* Brolemann (1919) based on both sexes from the French Pyrenees. I have not seen specimens from Algeria but I have studied larvae from Isle Porquerolles and Fos, France and a male genitalic slide from Mollaro, Italy[2]. These specimens are in poor condition but could represent *territans*.

Although the important specific characters of this species are relatively constant (form of palpi in both sexes, male genitalia, certain pupal hairs), there is considerable variation in markings of the scutum and abdomen, and in such larval characters as branching of dorsal head hairs, shape of the siphon and length of the siphon tufts. The dorsal head hairs are usually both single but one or both may be double, and rarely the upper hair may be triple. The siphon is usually shaped as in figure 19 but may be shorter or more constricted toward the apical one-third. Some Louisiana and Texas specimens have unusually short siphon tufts and those from Alaska are generally long. In various sections the siphon may have an indistinct, broad, pigmented band near the middle. Michener (1945) reported variation in this species from southeastern United States and showed a seasonal correlation. He concluded that a summer form with lighter pigmentation and with the siphon more slender and constricted could be separated from a winter form. Adults of the summer form were smaller, with lighter integument, more pale scales on the legs and reduced abdominal bands. Variation was also correlated with food supply, larvae from turbid pools being larger and darker than those from clear pools.

Culex (Neoculex) apicalis Adams

(Figures 11–14, 23, 24)

Culex apicalis Adams, 1903. Kans. Univ. Sci. Bul. 2 (2): 26. Type: female, Univ. Kansas.

Culex apicalis Adams of Freeborn, 1926. Univ. Calif. Publ. Ent. 3: 425. Male, female, larva (not figure of larva).

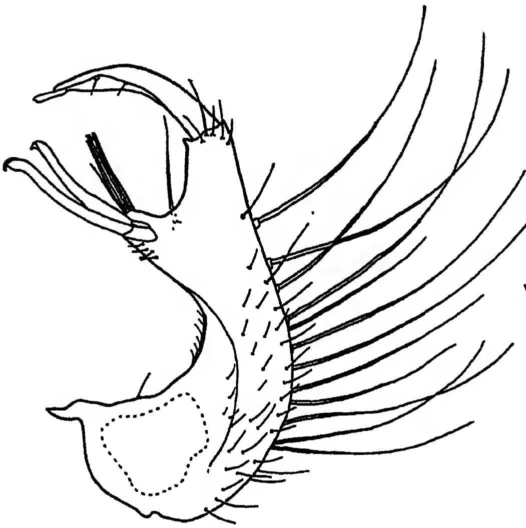
Female.—Palpus about three times as long as flagellar segment IV seen in lateral view, usually a few whitish scales at base of terminal segment and apex of subterminal one; upright forked scales of vertex pale to light brownish. Thoracic integument brown to dark brown, scutal scales greyish, somewhat shaggy in arrangement, sometimes forming a central line and a curved lateral line; hind femur with a ventral

[2]These European specimens were from the U. S. National Museum collection.

EXPLANATION OF PLATE II

Fig. 11, Winslow, Arizona. Fig. 12, Prescott, Arizona. Figs. 13, 15–18, Green Valley, Solano Co., California. Fig. 14, Oak Creek Canyon, Arizona.

FIGS. 11–14. *C. apicalis*. Fig. 11. Sidepiece. Fig. 12. Apex of sidepiece. Fig. 13. Mesosome. Fig. 14. Male palpus and proboscis. Figs. 15–18. Paratypes of *C. reevesi*. Fig. 15. Sidepiece. Fig. 16. Apex of sidepiece. Fig. 17. Mesosome and tip of one paraproct. Fig. 18. Male palpus and proboscis.



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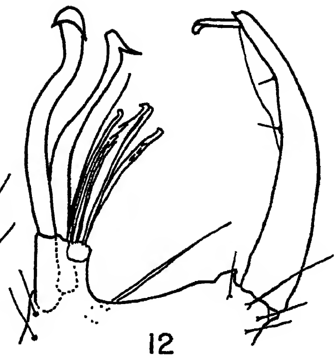

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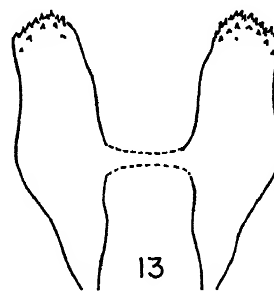

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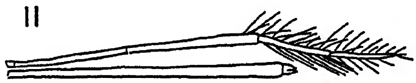

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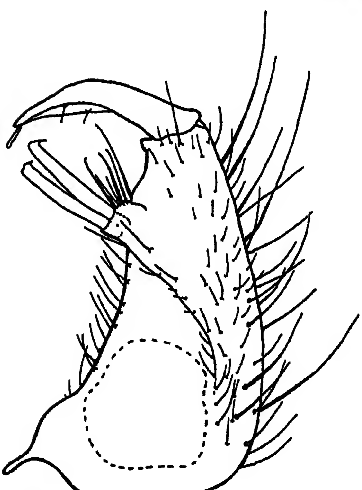
Culex apicalis



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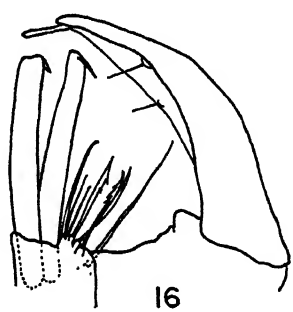

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17

18

Culex reevesi

pale stripe which is interrupted near apex. Apical abdominal bands usually broadened beneath into spots.

Male.—Palpus moderately haired (fig. 14), long hairs at apex of "long" segment occupying a space not more than one-half as long as terminal palpal segment, last two segments slightly less than one-half as long as proboscis, some whitish scales usually present at middle of "long" segment. Apical abdominal bands tending to be triangular, segments V and VI longer than broad. Genitalia (figs. 11–13): mesosome lobes connected by a membranous and unpigmented bridge; basistyle strongly constricted at middle, hairs along inner margin below subapical lobe fine and short; subapical lobe with two strong apically hooked setae of which the more basal is the longer and more crooked, six other setae of which the three most apical have fine, backward-pointing spines; dististyle with two distinct hairs, apical tooth moderate.

Larva (figs. 23, 24).—Antenna constricted at apical fourth, dark at base and beyond constriction; unpigmented between; upper head hair (C) double or triple (usually triple from type locality) and about half as long as lower head hair (B) which is double or rarely single. Mesothoracic submedian hair (hair 1) about one-third as long as antennal shaft, usually double; thorax densely pilose at 100 X magnification. Submedian hairs of abdominal tergite I and II single to triple and less than one-sixth antennal length; abdominal segments rather evenly pigmented. Siphon seven to eight times its basal diameter, very slightly inflated toward apex which is about five-ninths basal diameter; ten or eleven scattered hairs beyond pecten, basal ones usually quadruple and one-seventh to one-eighth siphon length; pecten on basal two-fifths of tube, middle tooth about four dentate. Lateral hair of anal segment usually double and fairly strong, gills usually shorter than saddle.

Pupa.—Submedian hair tuft at apex of abdominal tergite II with a short stem which divides into seven or eight strong straight branches; tuft about two-fifths as long as tergite III. Lateroapical hair tuft of tergite VIII with an average of 4.3 branches (58 tufts examined from three localities in central California: 5 triple, 32 quadruple, 17 quintuple, 4 sextuple).

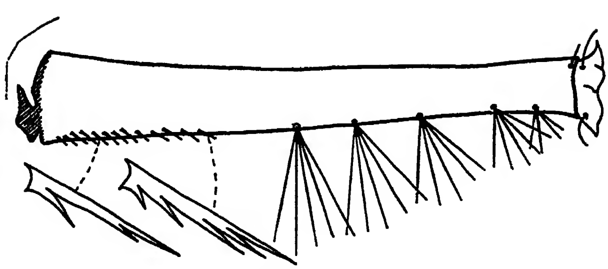
Distribution.—Widespread in California at moderate and low elevations wherever there are shaded creek pools. It is also known from stream canyons in Central Arizona.

Material Examined.—Two hundred and thirty adults and numerous larvae and pupae from the following localities: ARIZONA: Oak Creek Canyon* (including type female from University of Kansas), Prescott,* Winslow. CALIFORNIA: Humbolt Co.; Portola, Plumas Co.; Vina,

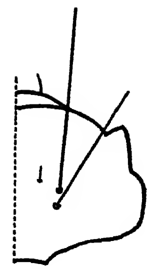
EXPLANATION OF PLATE III

Larval siphon and head characters. Siphons (figs. 19, 21, 23, 25) in lateral view, heads (right side only) in dorsal view. Figs. 19 and 20, Williamsburg, Virginia. Figs. 21 and 22, Prescott, Arizona. Figs. 23 and 24, Oak Creek Canyon, Arizona. Figs. 25 and 26, Green Valley, Solano Co., California.

FIGS. 19 and 20. *C. territans*. Figs. 21 and 22. *C. arizonensis*, paratype. Figs. 23 and 24. *C. apicalis*, topotype. Figs. 25 and 26. *C. reevesi*, paratype.



19. territans



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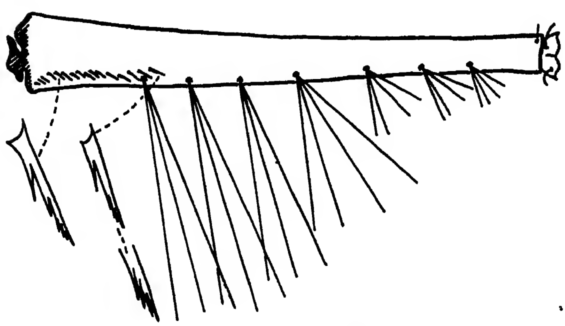
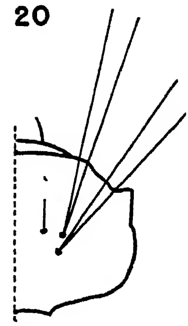


21. arizonensis



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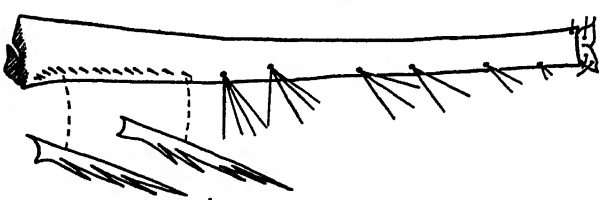
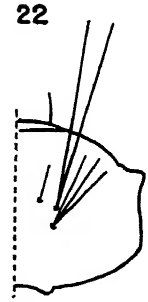


23. apicalis



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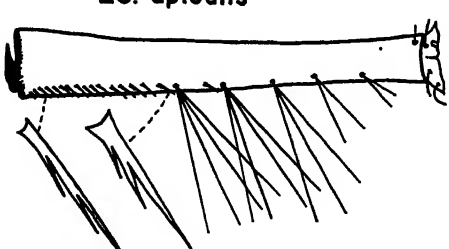
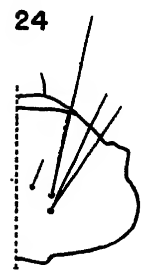


25. reevesi



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Butte Co.; Grass Valley and Nevada City, Nevada Co.; Placerville, Colfax and Auburn,* Placer Co.; Pacific Valley, Alpine Co.; Jackson, Amador Co.; Monticello,* Napa Co.; Green Valley,* Solano Co.; El Verano and Mt. St. Helena,* Sonoma Co.; Point Reyes and Alpine Lake, Marin Co.; Moraga Valley, Walnut Creek and Lafayette, Contra Costa Co.; Sunol, Alameda Co.; Soulsbyville and Sonora,* Tuolumne Co.; Palo Alto* and Alum Rock Park, Santa Clara Co.; Santa Cruz, Santa Cruz Co.; Pacheco Pass, Merced Co.; Elderwood, Springerville and Orosi (larvae), Tulare Co.; Kern River Cyn.,* Kern Co.; Ventura, Ventura Co. (larvae); Boquet Canyon, Los Angeles Co.; San Bernardino San Bernardino Co. (larvae); Campo and Mt. Palomar, San Diego Co.

Biology.—The species has not been observed to feed upon man and according to Freeborn (1926) "The females confine their blood meals to cold-blooded animals and possibly to frogs alone, these furnishing the only hosts that the writer has noted". In the same paper Freeborn states that, "The eggs are deposited in rafts above the water level. It has always been supposed that rising water submerged these eggs and caused their hatching. Yet, after early summer, when the breeding waters are gradually declining, all stages of larvae are constantly present, which would indicate that one of two possibilities happens. The larvae may be able to hatch without wetting and fall into the water below like tabanids, or, as the season grows drier, the attachment of the eggs may dry up until the eggs fall off into the water and the hatching ensues."

Regular observations were made during 1947 from January 2 through December 3 on the occurrence of *apicalis* in small streams of Solano and Napa counties. Larvae were first collected on April 8 and were mostly first and second instar. From April 26 through October 15 all stages were present in abundance in partially shaded streambed pools. Egg rafts were collected from the moist edges of pools on August 7 and 18. On November 4, after pools had been flushed by rain-swollen streams, only a few larvae, all mature, and a few pupae were collected. On November 19 no immature forms could be found but two females were collected in a stone culvert about 0.5 mile from the nearest breeding source. On December 3 another female was taken at the same place. Although evidence is scanty, it appears that the species passes the winter as adult females in hibernation.

Associated species in California are usually *Anopheles punctipennis* (Say), *Culiseta incidens* (Thomson), *Culiseta maccrackenae* Dyar and Knab, and *Culex reevesi* R. Bohart. Near Prescott, Arizona it occurs with *Culex arizonensis* R. Bohart.

Systematics.—The male palpi and genitalia appear to be diagnostic. Female specimens with definite scutal stripes may be confused with *arizonensis* except for the markings of the hind femora. In the larva the principle difference from *territans* is the greater development of microsetae on the thorax. This is readily appreciated by comparison but can be misunderstood when only one species is examined. In *apicalis* the siphon averages somewhat more slender and the tufts are shorter. The head hairs of *apicalis* are usually more divided but this is subject to variation. Twenty-six larvae were selected at random from two localities in California and two in Arizona. Of the upper head

hairs (C) twenty-four were triple and twenty-eight were double; of the lower head hairs (B) fifty-one were double and one was single.

Culex (Neoculex) arizonensis, new species

(Figures 6–10, 21, 22)

Female.—Length of wing 4.0 mm. Vertex with white curved scales, a lateral spot of white and black broad appressed scales, median area and nape with dark brown upright forked scales; mouthparts dark, palpus about three times as long as flagellar segment IV as seen in lateral view. Scutal integument dark brown, a broad central line of whitish scales reaching to antescutellar space and then forking, a submedian dark stripe of equal breadth bearing a few minute purplish scales, fossal area mostly covered with pale scales which extend backward in two lines of which the inner is narrow and the outer is broad; scutal bristles strong and dark; scutellum with narrow curved pale grey scales; postscutellum dark brown; anterior pronotal lobe with some pale broadened scales; posterior pronotal lobe with a few curved scales only, sternopleuron with two large patches of pale scales and mesepimeron with one patch, one lower mesepimeral bristle; wing dark scaled; halter knob with pale scales; femora with a broad pale line beneath on basal five-sixths only of hind femur; tibiae and tarsi dark. Abdominal tergites with apical whitish bands which are scarcely broadened beneath, venter greyish white.

Male—Length of wing 3.5 mm. Palpus with sparse and relatively short hairs, "long" segment with a few erect hairs near apex, last two segments together about two-fifths as long as proboscis, last segment with three or four moderate hairs on inner side and one or two toward base of outer side. Scutal pattern nearly as distinct as in female. Abdominal segments V and VI longer than broad. Genitalia moderately stout, not much exserted; mesosome narrowly but distinctly bridged, broad and with many tubercles at apex; basistyle rather stout, with numerous long hairs in a patch on inner margin below subapical lobe; latter with two strong, spoon-shaped setae of which basal one is slightly longer, and seven filaments of which apparently only middle one has a few backward-pointing spicules; dististyle with two bristles.

Larva (description based on thirty-seven paratypes).—Antenna constricted and tufted at apical third, dark at base and toward tip, light brown between; upper and lower head hairs (C and B) double, equal, about one-third longer than antennal shaft, slender and single; clypeal spine slender, light brown; mentum with about fifteen teeth. Shoulder hairs 1, 2, 5 and 6 single, 3 usually triple, 4 double, 7 usually triple; mesothoracic submedian hair (hair 1) slightly more than half as long as antennal shaft, with four to seven branches; thorax densely pilose at 100 X magnification. Submedian hairs of abdominal tergites I and II triple to octuple, those on II about one-third as long as antennal shaft; abdominal segments rather evenly pigmented. Comb of about fifty-five apically fringed teeth in a patch; third pentad with eight to eleven branches, fifth pentad with three or four branches; siphon about seven times its basal diameter, not appreciably inflated at apex which is about four-ninths basal diameter, basal one-fourth darkened; about

twelve scattered, double to quadruple siphon hairs, basal one sometimes within pecten and about one-third siphon length, apical ones small; pecten with about fifteen apically fringed teeth located on basal fourth of siphon, middle tooth four to five dentate. Gills slightly longer than saddle, very slender; lateral hair of anal segment double, outer caudal hair single, inner caudal hair usually quadruple.

Pupa.—Submedian hair tuft at apex of abdominal tergite II with ten to twelve strong branches from the base, about two-thirds as long as tergite III. Lateroapical hair tuft of tergite VIII with an average of 6.5 branches (16 tufts examined: 1 quintuple, 7 sextuple, 7 heptuple and 1 octuple).

Type (U.S. National Museum No. 58662).—Male, 8 miles S. E. Prescott, Arizona, August 25, 1947, reared from larvae in shaded creek-bed pool (R. Bohart). Paratypes, 69 males, 62 females and 48 larvae collected with the type.

Other Material Examined.—Males and females, Prescott, Arizona, June and July, 1934 (CCC Survey); male, Wolf Creek near Prescott, Arizona, July 27, 1939 (W. C. Reeves).

Biology.—The type series was collected from creekbed pools shaded by a bridge and by oak trees. The pools were teeming with larvae, most of which were *arizonensis* in all stages and a few of which were *C. apicalis*. Adult females were numerous about the pools but did not attempt to bite.

Systematics.—The reduced hairing of the male palpus, the stout basistyle and the long siphon tufts indicate a relationship with *reevesi* R. Bohart. Good recognition characters are the distinct scutal lines in the adult and the equal, double head hairs of the larva. However, occasional specimens of *territans* and *apicalis* have distinct scutal lines, and the larval head hairs may be subject to variation in other localities where *arizonensis* may be found. Most diagnostic are the long hairs of the inner margin of the basistyle in the male, the fringed larval pecten teeth, and the submedian hair tuft of tergite II in the pupa. The dark basal band of the siphon is slightly variable and occasional specimens have the siphon dark throughout.

Culex (Neoculex) reevesi, new species

(Figures 15–18, 25, 26)

Female.—Length of wing 3.5 mm. Vertex with brownish-yellow. curved scales, a lateral spot of pale broad appressed scales, median area and nape with light brown upright forked scales; mouthparts dark, palpus about twice as long as flagellar segment IV as seen in lateral view. Scutal integument medium brown, scales mostly minute and dark coppery, a pair of lighter scale spots near middle of scutum (sometimes indistinct); scutal bristles strong and dark; scutellum with minute yellowish curved scales; postscutellum light brown; anterior pronotal lobe with some pale broadened scales, posterior pronotal lobe with a few curved scales only, sternopleuron with two large patches of pale scales and mesepimeron with one patch. One lower mesepimeral bristle; wing dark scaled; halter knob with pale scales; femora with a complete broad pale line beneath, tibiae and tarsi dark. Abdominal tergites

with apical bands of yellowish scales which are broadened into spots beneath, venter pale yellowish.

Male.—Length of wing 3.0 mm. Palpus with sparse and relatively short hairs, "long" segment with erect bristles at extreme tip only, last two segments together about two-fifths as long as proboscis, last segment with a few moderate hairs toward base on inner side. Scutal scales minute and coppery, discal spots barely visible. Abdominal tergites with narrower bands than in female, segments V and VI broader than long. Genitalia stout, not much exserted; mesosome broadly bridged, narrow and with relatively few projections at apex; paraproct with stout and blunt teeth; basistyle short and stout, with some moderate hairs along inner surface, subapical lobe (figs. 15, 16) with six slender filaments of which three most apical are barbed; dististyle with two bristles.

Larva (description based on forty-two specimens from Napa, Solano, Merced, Tuolumne and Plumas Counties, California).—Antenna constricted and tufted at apical third, dark at base and toward tip, nearly colorless between; upper head hair (C) double or rarely triple and about two-thirds as long as lower head hair (B) which is single and about one-fourth longer than antennal shaft, d slender and single; clypeal spine slender, light brown; mentum with about fourteen teeth. Shoulder hairs 1, 2, 5 and 6 usually single, 3 single to quintuple, 4 single or double, 7 double or triple; mesothoracic submedian hair (hair 1) double to quadruple, usually triple, one-third to two-fifths as long as antennal shaft; thorax moderately spicular-pilose at 100 X magnification. Submedian hairs of abdominal tergites I and II double to quintuple, about one-eighth as long as antennal shaft; abdominal segment IV unpigmented in contrast to other segments (most evident in living specimens). Comb of about fifty apically fringed teeth in a patch; third pentad with seven to nine branches, fifth pentad with two or three branches; siphon about six times its basal diameter, about ten scattered, double to quadruple siphon hairs, basal one about one-third siphon length, apical ones small; pecten with ten to seventeen teeth, apical ones usually irregularly spaced and enclosing basal siphon tuft, middle tooth two to three dentate. Gills from one-third (type locality) to one and one-half times as long as saddle, depending upon locality; lateral hair of anal segment double or single, outer caudal hair single, inner caudal hair triple to quintuple.

Pupa.—Submedian hair tuft at apex of abdominal segment II weak, with three or rarely four to five branches on a relatively long stem, about one-third as long as tergite III. Lateroapical hair tuft of tergite VIII with an average of 2.0 branches (140 tufts examined: 26 single, 92 double, 21 triple and 1 quadruple.

Type (U.S. National Museum No. 58663).—Male, 1 mile S. Monticello, Napa Co., California, October 8, 1947, reared from larva in shaded creekbed pool (R. Bohart). Paratypes, 31 males and 44 females, same locality as type, October 8 to November 4, 1947; 16 males and 21 females, Green Valley, Solano Co., California, August 29 (H. E. Cott and R. Bohart) and September 12 (R. Bohart), 1947, reared from larva in shaded pools near creek.

Other Material Examined.—CALIFORNIA: Canyon Dam* and Blairsden,* Plumas Co.; Vina, Butte Co.; Auburn, Placer Co.; Lake Tahoe, El Dorado Co.; Sebastopol, Sonoma Co.; Conn Lake,* Napa Co.; Stockton, San Joaquin Co.; Sonora,* Tuolumne Co.; Palo Alto, Santa Clara Co.; La Honda (larvae), San Mateo Co.; Watsonville, Santa Cruz Co.; Snelling,* Merced Falls* and Yosemite Valley, Merced Co.; Monterey,* Monterey Co.; Visalia and Orosi,* Tulare Co.; San Diego, San Diego Co.

Biology.—The larvae occur in partially shaded streambed pools and along creek margins where there is an abundance of vegetation. They are often, but not always, associated with *Lemna*. On April 29, 1947, I collected them with *Aedes fitchii* (Felt and Young) and *Anopheles freeborni* Aitken in an open, reedy, algal pool near Crescent Mills, Plumas County. On the same day others were taken with *Aedes increpitus* Dyar in a pinecone-filled pool from melting snow near Canyon Dam, Plumas County. Both localities are about 5,000 feet in elevation. Other records from moderate to low elevations in the Sierras include dates from May to July. At low elevations and in southern California, records are mostly from August to November, from drying streams. Here the larvae are usually associated with *C. apicalis* and may become abundant. Where both *Neoculex* species occur together, *reevesi* is readily distinguished by the speckled appearance of the abdomen, the shorter siphon and the more nearly horizontal position of the body at the surface of the water. *C. reevesi* larvae are much more shy than those of *apicalis* and, when disturbed, will lie for long periods on the bottom. Nothing is known of the adult habits.

Systematics.—This species has generally been confused with *apicalis* by previous workers. What appears to be the same mosquito was described in manuscript in 1943 by Pedro Galindo in his unpublished Master's Thesis on the genus *Culex* in California. I am glad to follow Mr. Galindo's suggestion (in a letter) that I describe the species and name it after Dr. W. C. Reeves of the Hooper Foundation, San Francisco, in recognition of his numerous contributions to our knowledge of California Culicidae.

C. reevesi can be recognized in its various stages by the characters given in the key. The female is sometimes difficult to distinguish from that of *territans*, but *reevesi* is smaller, has the pale markings somewhat yellowish, and has a stouter abdomen. The light color of the thoracic integument is striking in many examples but is subject to considerable variation. The dorsal abdominal bands may be reduced to lateral spots in both sexes but this does not appear to be of geographical significance. The length of the larval gills is fairly constant in any one area but varies greatly between areas. For example, a series of specimens from two localities in Plumas County at an elevation of about 5,000 feet all have gills much longer than the saddle; a series from three foothill localities in Merced and Tuolumne Counties have the gills about three-fourths as long as the saddle; and specimens from several localities in Napa and Solano Counties have the gills from one-third to one-half as long as the saddle. The head hairs are relatively constant. In forty-one specimens from various localities four upper head hairs (C) were triple and seventy-eight were double. All eighty-two lower head hairs (B) were single.

Culex (Neoculex) derivator Dyar and Knab

Culex derivator Dyar and Knab, 1906. Jour. N. Y. Ent. Soc., 14: 216.

The range of *derivator* is reported to be Mexico and Costa Rica. I have studies specimens of adults and larvae from Bambito, Chiriqui, Panama which appear to be this species. They were sent to me by Mr. Pedro Galindo who reared the larvae from streambed pools. The male palpus is similar to that of *territans*, whereas the female palpus is long as in *apicalis*. The abdominal tergites have lateral apical spots only, as in some specimens of *territans* and *reevesi*. The male genitalia are similar to those of *apicalis* except that the mesosome lobes are connected by a slender sclerotized bridge. The larvae combine characters of several other species. As in *arizonensis*, the head hairs are double and nearly equal, and the pecten teeth tend to be apically fringed. However, the siphon has no broad basal pigmented band. As in *apicalis*, the mesothoracic submedian hair is less than half as long as the antenna, and the siphon hairs are fairly short.

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STUDIES ON THE BIOLOGICAL REQUIREMENTS OF THE CAT FLEA

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INTRODUCTION

This paper is the result of a series of studies on the nutritional and environmental requirements of the cat flea, *Ctenocephalides felis* Bouché, made in an effort to determine some of the fundamental biological necessities of the species.

Some valuable information was gleaned from a review of literature, although no real study could be found on the nutritional and environmental requirements of the cat flea larva; or as a matter of fact, of any species of flea. A study by Sikes (1931) on the rat flea *Orchopeas howardi* Baker, indicated that larvae of this species developed best in a dried blood and sand mixture in equalibrium with a relative humidity of 80 per cent at 21° C. Sikes found that no larval survival occurred at humidities below 70 per cent. All of his trials showed low survivals even with the most favorable conditions. On an average only 24.2 per cent of the larvae matured in an atmosphere of 80 per cent relative humidity. The best single trial had a maturity of 18 of 25 larvae or 72 per cent. Sikes also found the rat flea larva was not specific in regard to the origin of the dried blood used. Rifenburgh (1927) used an excellent method of obtaining flea eggs from dogs. The animals were housed in cages which possessed a hardware cloth floor. Beneath the floor was spread a piece of paper onto which the flea eggs and debris fell. Eggs were sifted from the debris and placed into small crystallizing dishes with finely chopped rat feces. Leeson (1932) reared flea larvae of several species of rat flea from eggs secured from mice. The larvae were reared at 74° F. in a moist incubator. Parman (1923) indicated a temperature of 70°–80° F. was desirable for rearing the larvae of the hen flea, *Echidnophaga gallinacea* Westwood, on food derived from the floor dust of the hen coop.

From these few facts the author made his plans for experiments on the cat flea larvae to determine the limiting environmental elements and the conditions needed for maximum maturity of the cat flea larvae. The dietary studies were conducted to find some of the essential components in the larval diet, and thereby improve the nutrition of the larvae.

TECHNIQUE OF STUDY

Since this was to be a method for use in laboratories a reasonable number of fleas had to be reared on a small amound of food within laboratory containers. Therefore, a convenient 9 cm. petri dish was selected for rearing flea larvae. The practical measure of efficiency in the various experiments was the number of larvae that could be reared

to maturity from 100 viable eggs; the maximum size attained by the larvae; and also the length of larval stage in days. Eggs for all tests were procured from a large sheet of paper which was placed beneath the hardware cloth floor of a cat cage. Two cats were found adequate to supply 1,000 to 3,000 eggs daily. The eggs which fell from the cats onto the underlying paper were sifted through two screens (14 mesh and 38 mesh) and retained on the third and finest screen (48 mesh). The material in the third screen usually contained about 85 to 90 per cent eggs, the remaining 10–15 per cent being skin scales, debris, and flea feces. A convenient method was found for obtaining only fertile eggs for the cultures. Eggs were incubated for 24 hours, or until the developing embryo could be detected with the aid of a binocular microscope. Thus with the use of a small aspirator and a binocular microscope 100 viable eggs in the same stage of development were selected for each petri dish. A simple aspirator was developed by the author for creating a vacuum which was needed to operate the tiny collecting mechanism used to pick up the eggs. The aspirator consisted merely of a glass T tube with a smaller glass capillary tube fitted into one half of the top of the T. The capillary tube was connected to an air pressure tap. This simple gadget operates on about the same principle as does the common laboratory water aspirator. All foods used were ground to a powdery state in a small ball mill. The sand, used as a substrate, was first washed in concentrated HCl and then fired in a crucible. This removed soluble salts and destroyed all organic matter that might have contaminated the fine sea sand. A temperature of 80° F. and an atmospheric relative humidity of 80 per cent were arbitrarily selected for all experiments except those where a study of temperatures and humidities were made. The affecting variables studied were in order as follows: quantity of dried blood, quantity of sand, amount of dried brewer's yeast, crowding effect, diameter of rearing dish, temperature, humidity, food materials, essential dietary components, and synthetic diets.

EXPERIMENTAL RESULTS

1. *Relationship of Quantity of Food to Development.*—The first information sought was that on the quantity of dried beef blood most desirable for rearing 100 larvae in a petri dish. In each test, the amount of powdered dry blood was 25, 50, 100, 200, 400, 800, 1600, and 3200 mg., respectively, mixed with washed sea sand varying from 0.125 to 16.0 grams. The results of these tests indicated that with a mixture of one part of blood in five parts of sand by weight, at least 800 mg. of blood was required for rearing the maximum number of larvae from 100 viable eggs.

Competition for food was apparently keen among larvae where less than 400 mg. of dried blood was used. Even where none of the larvae reached maturity, only a small part of the food was consumed. This would lead one to believe that feeding was a chance occurrence, and that increasing the amount of food increased the chance that some or all of the larvae would feed sufficiently to reach maturity. With insufficient food the minimum number of days for larval maturity was nearly doubled, besides producing slightly smaller individuals.

This may be explained by the fact that with less food the larva spent more time in search of food in order to reach the required prepupal size.

It would seem apparent that at least 800 mg. of dried blood per petri dish is desirable to produce a maximum number of fleas from 100 eggs in the shortest possible time. Therefore, 1 gram of dried powdered food per 100 eggs was used in succeeding experiments.

2. *The effect of Various Amounts of Sand Upon Larval Development.* Seven tests were run to find what ratio of sand to blood would be most desirable. In each test 100 viable eggs were placed in a petri dish with 1 gram of blood and 0.0, 0.5, 1.0, 2.0, 4.0, 8.0, and 16.0 grams, respectively, of sand.

From the results it seemed apparent that the scope of the experiment on the quantity of sand was bounded on one side by the inability of the larvae to properly feed and pupate in the crowded environment of no sand, and on the other side by the inability of the larvae to find the food in too much sand. The highest per cent maturity occurred with media containing 1 to 8 grams of sand per petri dish. Four grams of sand for each gram of dry food was selected as a desirable quantity for the following experiments.

3. *The Effect of Yeast Upon the Development of the Flea Larvae.* Because that brewer's yeast is often used to promote growth in laboratory insects, a series of eight diets containing 1 gram of desiccated beef blood with 0.0, 10.0, 50.0, 100.0, 200.0, 400.0, 800.0, and 1600 0 mg. of brewer's yeast were formulated. The usual 100 eggs and 4 grams of sand were placed in each diet to determine the quantity of yeast most beneficial to growth. The per cent survivals for these tests were 75, 78, 95, 81, 75, 69, and 65, respectively. It would appear from the data obtained that 50 to 100 mg. produced the greatest influence on rate of larval growth and the number to reach maturity.

Too much brewer's yeast was apparently detrimental to larval development. Perhaps the larvae in the presence of much yeast ate it in exclusion of the blood and thus had an unbalanced diet. It is logical to assume that the dried blood was lacking in some growth promoting substance which the brewer's yeast supplied. The dried beef blood used in these experiments was prepared by baking whole blood in an oven at 210° F. for at least 24 hours or until all free water had evaporated. Undoubtedly this heating would inactivate or change certain vitamins or other growth promoting substances, and thus made the whole dried blood deficient in these materials. In any event, the addition of about 5 per cent by weight of brewer's yeast proved to be most beneficial in this experiment.

4. *The Crowding Effect on Flea Larvae.* Eight tests were made to determine how many fleas could be reared in a 9 cm. petri dish, when food material was increased proportionally to the number of eggs, without materially affecting the survival.

The per cent survivals for the containers having 10, 25, 50, 100, 200, 400, 800, and 1,600 larvae were, respectively, 100, 85, 96, 97, 85.5, 77.25, 50.1, and 32.3. These results are not easy to explain unless the physical nature of the media and the feeding habits of the larvae are considered. The greater density of the media and the apparent preference of the larvae to feed in the top stratum probably caused enough competition

(crowding) to lower survival in the petri dish containing the greatest depth of media and proportionally the smallest top surface area per larva. It was apparent from the results that the condition referred to as crowding existed when more than 200 individuals were reared in a 9 cm. diameter petri dish.

5. *Effect of Container Size on Larval Growth.* Another ramification was a study of the influence of a change in the diameter of a container upon the per cent maturity from 100 eggs. The diet used consisted of 1 gram desiccated beef blood and four grams of sand with 50 mg. yeast, and was placed in 1, 2, 5, and 10 cm. diameter containers. Here again, as in the previous experiment, the tendency of the larvae to feed in a certain stratum of the media may explain their low survival of only 12 per cent in the smallest container. The 2, 5, and 10 cm. diameter container had 89, 99, and 96 per cent survival, respectively.

6. *The Influence of Temperatures on Flea Larval Development.* The results thus far had indicated that the environment of 80° F. and 80 per cent relative humidity was quite satisfactory; but to dispel any doubts, four cultures were prepared and subjected to temperatures of 70, 80, 90, and 100° F. having the humidity constant at 80 per cent relative. These tests used what was called a standard culture, that is, a culture containing 1 gram desiccated beef blood, 4 grams of sand, 50 mg. of brewer's yeast, and 100 viable flea eggs.

The rate of growth of larvae at 90° or 100° F. was nearly twice as fast as at 70° F. The survivals for 70, 80, 90, and 100° F. were 90, 98, 99 and 34 per cent, respectively, and the minimum days to reach maturity were 9, 5, 4, and 4, respectively. Low survival at 100° F. may have been in part caused by the growth of mold over the surface of the dried blood which excluded and competed with the larvae for food.

7. *The Influence of Humidities Upon Flea Larval Development.* When the temperature was held constant at 90° F. and the relative humidity varied by Buxton's method (1931) from 35 to 100 per cent, data were obtained as follows: For 35, 40, 45, 95, and 100 per cent relative humidities no survival occurred; the survivals with relative humidities of 50, 55, 60, 65, 70, 75, 80, 85, and 90 per cent were respectively 24, 77, 79, 91, 99, 98, 99, 96, and 88 per cent. The results might indicate that the larvae of the cat flea are adapted to growth in a wider range of humidities than the rat flea which, as reported by Sikes (1931), would not grow with less than 70 per cent R.H. in equilibrium with the dried blood. At 50 per cent relative humidity, the rate of development was 2 to 3 times as long (12 days) as that of favorable humidities (4–5 days). It is not clear why the low humidity should lengthen the larval stage, but it follows other observations that unfavorable environmental factors reduce maturity and/or prolong the larval period. Excessive moisture of 95 to 100 per cent relative humidity produced such heavy molds upon the food that no larvae survived.

The data on the effects of temperatures and humidities did not cause a change in the remaining experiments with regard to temperature or humidity. The remaining described experiments used an atmospheric environment of 80° F. and 80 per cent relative humidity.

8. *Nutritional Studies With Flea Larvae.* The following experiment was performed to find, if possible, a better larval food and some of the

essential components in the diet of the flea larva. Table I shows the results of a number of test foods with three columns which indicate by a + or − the presence or absence of a quantity of food supplement. The purified vitamin-free casein (Bacto), the blood albumin (Merck), lactalbumin (Merck), celluflour (Bacto), glucose, agar agar (Merck),

TABLE I

VALUE OF VARIOUS NUTRITIVE COMBINATIONS TO THE FLEA LARVAE

One Gram Food	10 mg. Glucose	50 mg. Brewer's Yeast	40 mg. of Salt Mixture	Per Cent Maturity	Maximum Size		Minimum Days to Reach Maturity
					Length	Width	
Casein............	−	−	−	0	1.8	.23	....
"	+	−	+	12	3.5	.45	11
"	−	+	+	52	3.55	.47	12
"	−	+	−	0	2.2	.30	....
"	+	+	−	0	2.4	.31	....
"	+	+	+	80	3.9	.48	12
Lactalbumin.......	−	−	−	0	1.6	.24	....
"	+	+	+	88	4.0	.50	8
Dried Milk.........	−	−	−	0	2.7	.25	....
"	+	+	+	72	3.55	.46	6
Swift's dog food....	−	−	−	23	3.7	.47	7
Celluflour..........	−	−	−	0	3.1	.35	....
"	+	+	+	16	3.6	.47	12
Agar agar..........	−	−	−	0	1.5	.16	....
"	+	+	+	0	2.2	.19	....
Gelatin............	−	−	−	0	1.4	.18	....
"	+	+	+	0	3.4	.32	....
Brewer's yeast.....	−	−	−	35	4.0	.49	13
Yeast cake.........	+	−	−	20	3.5	.46	10
Dried mammalian Blood...........	−	−	−	62	4.1	.50	7
Dried beef blood...	−	−	−	85	4.1	.52	8
" " " ...	+	+	+	100	3.8	.53	4
" " " ...	+	+	+	92	4.0	.51	5
Desiccated red blood corpuscles..	−	−	−	52	3.8	.48	5
Dried blood Albumin.........	−	−	−	89	4.2	.55	4
"	−	−	−	96	4.1	.54	4
"	+	+	+	88	3.9	.50	4
Hemoglobin........	−	−	−	68	3.8	.48	9
"	+	+	+	84	3.8	.49	5
Fibrin.............	−	−	−	16	3.7	.46	19
"	+	+	+	100	3.9	.49	4
Synthetic diet......	+	+ 25 mg.	+	98	3.9	.49	8
" "	+	−	+	0.0	3.1	.40	....
" "	+	−	+	0.0	2.9	.39	....
" "	+	−	+	0.0	3.0	.39	....
" "	+	+ 25 mg.	+	61	3.8	.49	7

gelatin (Merck), fibrin (Merck), and hemoglobin (Merck) were all of high purity. Commercial grades of dried milk, brewer's yeast (Anheuser-Busch, Inc.), Swifts' dog food, and dried mammalian blood were incorporated in some diets. The salt mixture was prepared by the author to resemble quantitatively the ionic concentrations in human blood. The mixture contained 0.5 grams of calcium chloride, 1 gram of mono-

bacic potassium phosphate, 2 grams magnesium sulfate, 2 grams ferric citrate, 0.2 grams copper sulphate tetra amine, and 12 grams sodium chloride. These salts were intimately mixed in a ball mill as were all food mixtures in the nutritional studies. In addition to the experimental diets indicated above, some not very successful trials were made with completely synthetic diets composed of 24 amino acids (Eastman), vitamins, glucose, lipids, and salts. The composition of the amino acid mixture was as follows: 20 mg. glycine, 60 mg. alanine, 80 mg. valine, 180 mg. leucine, 80 mg. iso leucine, 80 mg. proline, 10 mg. hydroxyproline, 78 mg. phenylalanine, 220 mg. glutamic acid, 41 mg. aspartic acid, 20 mg. serine, 65 mg. tyrosine, 23 mg. cystine, 50 mg. histidine . HCl, 64mg. arginine . HCl, 193 mg. lysine . HCl, 23 mg. tryptophane, 35 mg. methionine 1.20 mg. dl-threonine, 40 mg. hydroxyglutamic acid, 20 mg. cysteine, 20 mg. 3.5—1—diiodotyrosine, 20 mg. dl–amino–n–valeric acid, 20 dl–amino–n–butyric acid. The proportions of amino acids were arbitrarily selected to simulate those by Womack and Rose (1936) in the study of the amino acid requirements of rats. The finished diet consisted of 85 per cent amino acids, 1.5 per cent Mazola corn oil, 0.5 per cent glucose, 2 per cent agar, and 4 per cent salt mixture. To each gram of the above mixture was added: 0.033 mg. thiamin, 0.047 mg. riboflavin, 0.33 mg. nicotinic acid, 0.14 mg. pantothenic acid, 0.021 mg. pyridoxine, 1.07 mg. ascorbic acid, 0.0029 mg. ergosterol, 0.043 mg. beta-carotent, and 0.02 mg. alpha-trocopherol. The various amounts of vitamins were calculated from the estimated minimum requirements per 70 grams of protein in the food of man. Folic acid, biotin, and choline, which are normally found in small quantities in blood, were missing in the synthetic diets. These could have been necessary constituents of the diet and would have been added had they been available at the time of the experiment. Experiments by Moore (1946) with carpet beetles indicated these to be important nutrilites.

The two most troublesome features of the synthetic diet were the deliquescense and the growth of fungi and bacteria when kept in an atmosphere of 80 per cent relative humidity. At the lower humidity of 65 per cent the above troubles were checked.

Vitamin free casein, lactalbumin, and celluflour diets lacked some essential materials necessary for larval growth. The addition of 10 mg. glucose, 50 mg. brewer's yeast, and 40 mg. of the salt mixture made these diets complete enough for larval development. On examining data on the casein diets it is evident that the addition of yeast gave the most increase in survival; however, only the salt mixture appeared to be essential. Glucose was not essential but did add some nutritive value to the casein diet.

Agar agar (Bacto), which is composed of complex carbohydrates, did not prove to be a food with or without the supplements. Gelatin, an incomplete protein, yielded no growth in flea larvae even with the supplement of sugar, yeast, and salts. This would suggest that the amino acids not present in gelatin (tryptophane, valine, and methionine) are essential to the growth of flea larvae. The addition of the supplements had a beneficial effect upon the nutritive value of fibrin and hemoglobin and were essential for nutrition with lactalbumin, celluflour, and dried milk. All of the blood components tested, except fibrin,

were good sources of larval food with or without the supplement. With supplements added, fibrin was an excellent source of food; this was only a reflection upon its purity.

The amino acid diets failed to nourish the flea larvae except those that contained 25 mg. brewer's yeast. These results certainly indicated the absences from the amino acid diet of some essential food materials which were present in yeast. Experiments by Trager (1937) and Crowell and McCoy (1937) also indicated that yeast was necessary for the development of insect larvae on synthetic diets.

In these experiments measurements of the larvae did not reveal any startling facts except that unless they attained a maximum length of about 3.5 mm. and a width of about 0.45 mm., they did not survive or pupate. Usually there was a correlation between percentage of survival, size of larva, and shortened time for development.

SUMMARY

A study was conducted with the larvae of the cat flea *Ctenocephalides felis* Bouché to determine food requirements and optimum conditions for growth and survival with the intention of developing a standardized laboratory rearing procedure.

1. The best growth and survival was obtained when larvae from 100 viable eggs were reared in a media consisting of 1 gram dried beef blood, 50 mg. brewer's yeast, and 4 grams of clean sand contained in a 5–10 cm. petri dish, and kept in an 80° or 90° F. atmosphere with 65–90 per cent relative humidity.

2. Dried beef blood, dried mammalian blood, desiccated red blood cells, dried blood albumin, hemoglobin, and fibrin were among the best larval foods. Casein, lactalbumin, celluflour, dried milk, brewer's yeast, yeast cake, and Swift's dog food were poor larval foods. Agar or gelatin would not support larval growth.

3. The synthetic diet of 24 amino acids, fats, salts, vitamins, etc. would promote flea larval growth only when brewer's yeast was incorporated in the food mixture.

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NEW NORTH AMERICAN TOMOCERINAE

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Since Folsom's review of the North American Tomocerinae in 1913, this group of Collembola has been well stabilized, and few additions (Denis, 1929; Mills, 1934; Bonet, 1934) have been made to our fauna.

With the new genus herein reported, the Holarctic genera now recognized number two, both occurring in North America and one presently restricted to this continent. The common genus *Tomocerus* is probably as well known, to persons not actively interested in the group, as any other in the Collembola. Its members are large, occasionally 6 mm. in length, metallic gray, active, and commonly encountered in rich decaying vegetation such as that in wooded areas. Occasionally species of *Tomocerus* will be found in caves, often incidentally, and a few have been modified to this habitat.

Tomolonus and the *Tomocerus* subgenus *Tritomurus*, however, approach more closely typical lucifuge forms, being blind or approaching it, pigmentless or with minute diffuse punctations, and with some modifications of the sensillae.

The purpose of this paper is to describe two new lucifuge species from the North American fauna, one of which represents a new genus. The genera and subgenera now known in the Tomocerinae can be separated by means of the following key:

1. Postantennal organ present.............. ....**Tomolonus** n. gen.
   Postantennal organ absent.................................**Tomocerus.** 2
2. Eyes present, 6 on either side of the head............................. 3
   Eyes absent or reduced to a single pigmented eyespot on either side, Subgenus **Tritomurus** Frauen.
3. Maxilla head bearing inwardly at its base a hairy, backward-pointing process (*prostheca*)...........................Subgenus **Pogonognathellus** Paclt[1]
   Maxilla head without a prostheca..............Subgenus **Tomocerus** Nicolet

Tomolonus, new gen.

Tomocerus-like in appearance and general characteristics. Antennae four-segmented, the last two annulate. Postantennal organs present. Eyes reduced in number, 2 + 2 in the only known species. Color white with diffuse punctiform pigment. A single anterior bristle on corpus tenaculi. Dental spines present. Dentes slender, with numerous dorsal crenulations. Mucro bearing numerous hairs.

Genotype: *Tomolonus reductus* n. sp.

Tomolonus reductus n. sp.

White, with minute, diffuse, punctiform pigmentation, more dense anteriorly and laterally on body segments and dorsally on head. Antennae, legs, venter, and furcula white. Eyespots small, irregular in

[1]*Pogonognathus* Borner preoccupied in fishes, and replaced by *Pogonognathellus* by Paclt (1944).

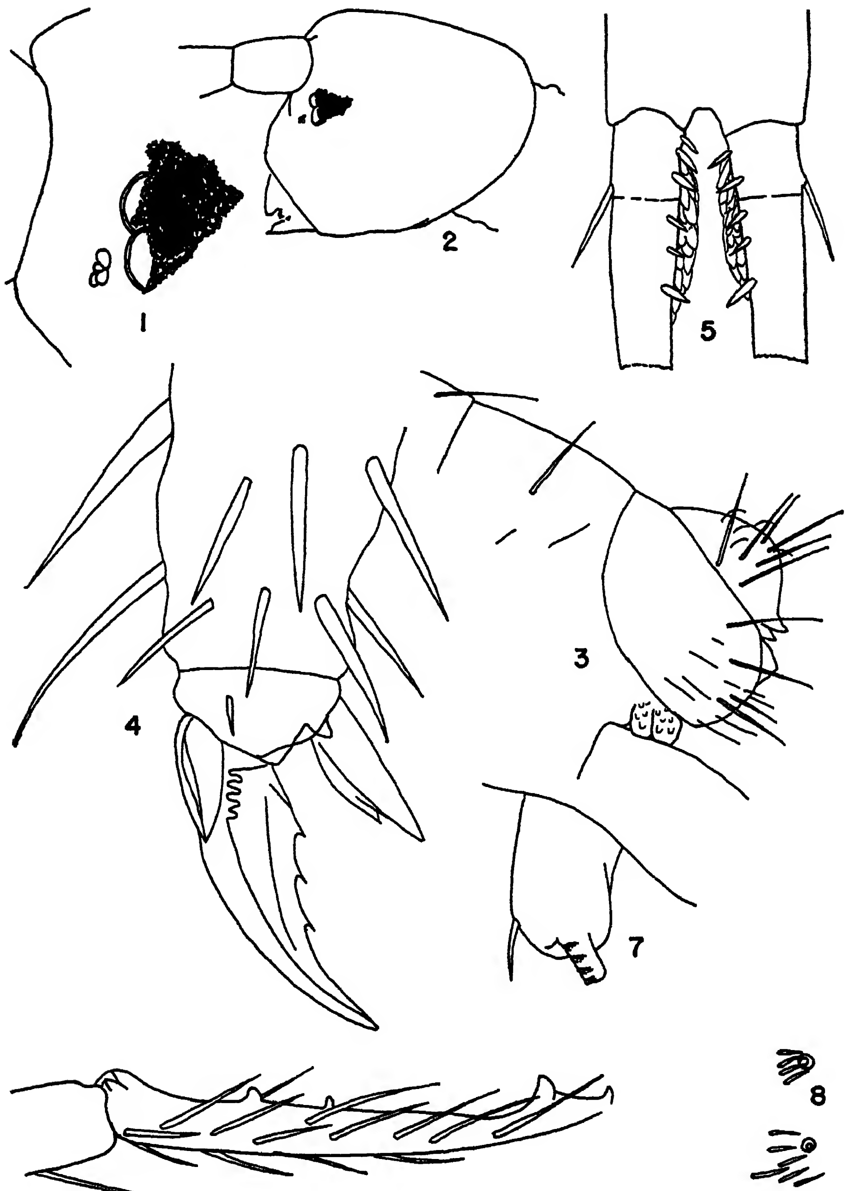
outline. Eyes, figs. 1 and 2, two on either side, at anterior edge of eyespot. Postantennal organ, fig. 1, smaller than an eye, consisting of four tubercles in an irregular rosette; close to and in front of the lower eye. Antennae not especially long but longer than the head, the segments about as 7 : 12 : 46 : 19. The two apical segments annulate as in *Tomocerus*. No specialized organs noted at tip of fourth antennal segment. Third antennal segment organ composed of two heavy, parallel-sided, blunt clubs. Third abdominal segment slightly longer than fourth, about as 6 : 5. Genital and anal segments distinctly separated, the three anal valves slightly bulbous, fig. 3. Unguis, fig. 4, with fairly broad, straight pseudonychiae, basal folds, and two or three inner teeth, the basal one subtended by an oblique ridge on ungual base. Unguiculus rather broadly lanceolate, with an inner tooth. Tenent hair slender, pointed, not greatly different from other tibiotarsal setae. No distal subsegment on tibiotarsus evident. Furcula slender. Manubrium scaled ventrally and setiferous dorsally. Dens scaled ventrally on basal half and hairy on apical quarter; hairy dorsally. Dens crenulate dorsally, to the mucro about as 36 : 13. Dental spine formula 2-3, **1**/2, **1**, the spines minutely striate, fig. 5. Mucro slender, fig. 6, hairy, with apical, subapical, two intermediate on the basal half, and two basal teeth, these latter teeth bearing small anterior-pointing lamellae. Corpus tenaculi with one short anterior bristle, fig. 7, the apex roundly truncate; rami quadridentate. Dorsal scales typically tomocerine, rounded at base and bearing rather coarse, parallel, longitudinal striae which extend beyond the apex to form minute teeth. Scales of the genal and gular area, as well as those of the furcula, pointed or rounded at apex; especially abundant on dentes just below the spines. Fringed dark hairs anteriorly on the mesonotum and on the fourth to sixth abdominal segments, becoming longer and more abundant posteriorly. Large hairs also present on manubrium, base of dens, coxae, precoxae, and ventrolaterally on body. Bothriotricha seen on mesonotum and third, fourth, and fifth abdominal segments, their bases guarded anteriorly by short spines, fig. 8. Maxilla head without prostheca. Mandible with four or five-toothed apex and a large, separated, striate and tuberculate molar surface one-fourth from the apex. Length 1.7 mm.

Cotypes.—Hastings Natural History Reservation, Monterey, California, February 14, 1946, 16 specimens; December 9, 1946, 3 specimens. From middens of *Neotoma*, J.M. Linsdale. In the collection of the Illinois Natural History Survey.

This species is unusual in several respects. It is the first tomocerine, to my knowledge, upon which a postantennal organ has been discovered. This structure, while small, is very apparent as is shown in the illustrations. Further, *T. reductus* possesses a reduced number of

EXPLANATION OF PLATE I

Tomolonus reductus n. sp. Fig. 1. Eyes, left side of head. Fig. 2. Left view of head. Fig. 3. Left aspect of apex of ♀ abdomen. Fig. 4. Right front foot. Fig. 5. Dental spines. Fig. 6. Left mucro. Fig. 7. Lateral view of tenaculum. Fig. 8. Bases of abdominal bothriotricha with adjacent guard hairs.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eyes, two corneae being visible on either side of the head. The tenent hair is reduced as is typical in the subgenus *Tritomurus*, but there does not appear to be the distal subsegmentation of the tibiotarsus which occurs in some species of that subgenus.

THE TOMOCERUS COMPLEX

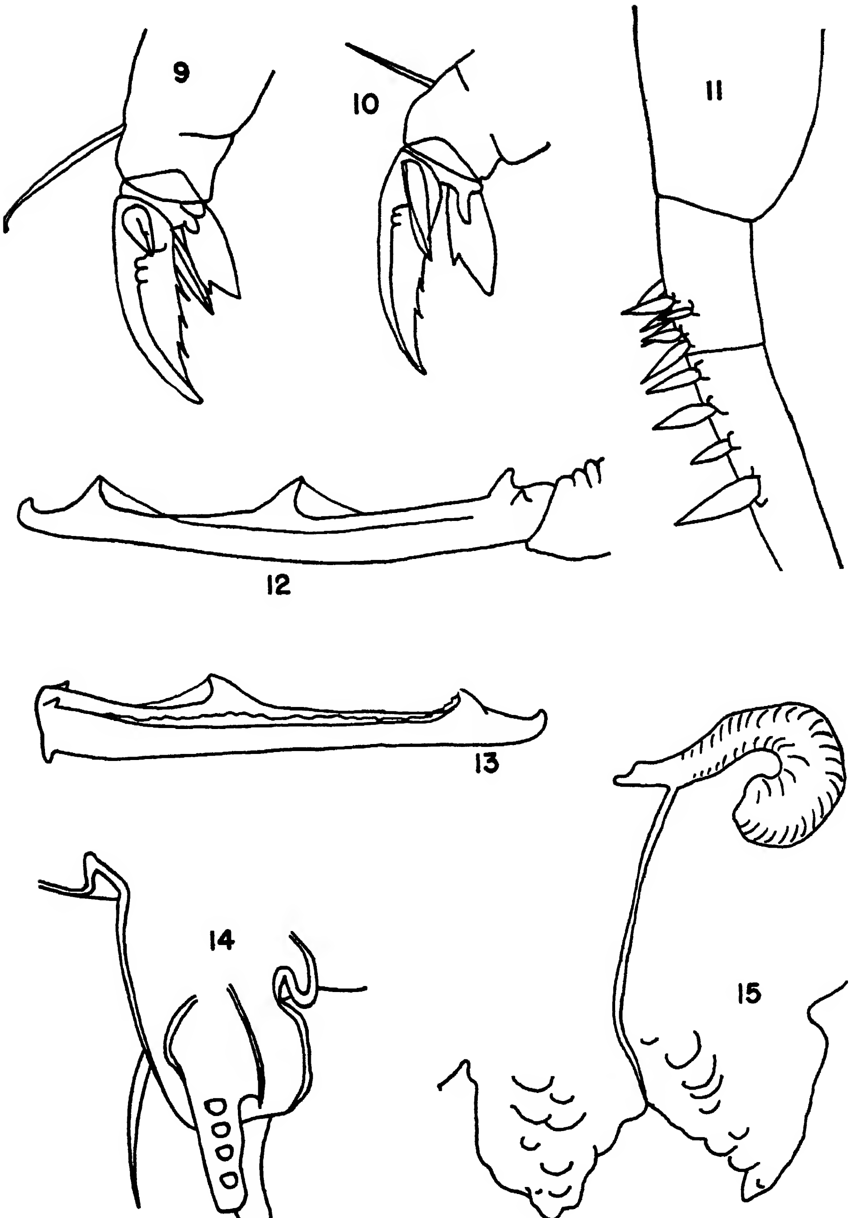
Laing (1945) has discussed the uncertain history of the name *Tomocerus*, and has pointed out that strict application of the International Rules of Zoological Nomenclature might necessitate radical changes in the understanding and application of *Tomocerus* and several other much used names in Collembola. More recently (Anonymous, 1947) there is indication that a request has been made to the International Commission on Zoological Nomenclature to suspend the rules and designate genotypes for *Tomocerus*, etc., which would bring these names into permanent use in the sense that they have been defined by Lubbock (1873), Folsom (1913), and others. Because *Tomocerus* has been in uninterrupted usage in its present sense for nearly a century, I feel justified in continuing to use *Tomocerus* in this sense and in supporting the aforementioned petition before the International Commission.

Tomocerus (Tritomurus) missus n. sp.

Color white, or with punctiform blue-gray pigment dorsally on head, and posteriorly to and including the fifth abdominal segment. Some pigment externo-laterally to the precoxae and third paratergite and some ventrally on the manubrium. Dorsal pigmentation broken by round or elliptical white areas, more conspicuously so on the mesonotum. Antennae not especially long, approximately twice the head diagonal. Apex bearing a slender hooked hair. Ungues, figs. 9 and 10, with three conspicuous inner teeth, long, slender pseudonychiae which are inwardly lamellate at base, and basal folds. Unguiculus broad, lamellate, with an inner tooth. Tenent hair somewhat variable, slightly bent and blunt at apex, or straight and pointed. Apex of tibiotarsus weakly subsegmented. Dens about 4.5 times the mucro, with numerous, transverse, dorsal corrugations. Dental spines, fig. 11, variable in number, the general formula of material at hand being 5-8 / 3-5, 1, rarely with another small spine beyond the large, typically apical, one. A series of long heavy hairs occurs beside the spine series. Mucro, figs. 12 and 13, long and slender, well covered with hairs which are not shown in the figures; with apical, anteapical, one median, and two basal teeth. The subapical and median teeth each with a lamella extending proximad. Corpus tenaculi, fig. 14, blunt, truncate, with one anterior curved seta; rami quadridentate. Eyespots and eyes absent. Maxilla head without a prostheca as is found in *Pogonognathellus*. Third abdominal segment to

EXPLANATION OF PLATE II

Tritomurus missus n. sp. Fig. 9. Right front foot, specimen from Grafton Cave. Fig. 10. Right rear foot, Eckert's Cave specimen. Fig. 11. Left dens showing spine arrangement. Fig. 12. Right mucro. Fig. 13. Left mucro. Fig. 14. Tenaculum, left view. Fig. 15. Female genital opening and spermatheca, lateral view.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fourth about as 6 : 5. Body well scaled, the typical tomocerine scales with parallel longitudinal striations and feathered or pointed tips. Mesonotal collar of nearly straight, heavy, pointed hairs. Similar but more pointed ones from the third to sixth abdominal segments, becoming longer and more abundant posteriorly; also on coxae and precoxae. Under highest magnification these hairs appear very finely and regularly pubescent. Short, pointed hairs abundant ventrally and laterally on head, legs, and collophore. Manubrium and dentes with short hairs dorsally; manubrium scaled ventrally, and dentes ventrally with heavy, broad, scale-like hairs. Bothriotricha noted on the first to fourth abdominal segments, the bases subtended by a series of minute, sharp, inconspicuous spines. Genital aperture of female with large anterior and posterior valves, covered with irregular bosses, fig. 15; duct leading inwardly to a partially coiled, striate spermatheca. Aperture of male small, the genital papilla covered with minute hairs; the duct fairly broad, somewhat tortuous, and ending in a slight enlargement into which two tubes from the testes open. Maximum length 3 mm.

Cotypes.—Grafton Cave, Jersey County, Illinois, January 1, 1944, 2 specimens, Charles L. Remington; April 8, 1944, 9 specimens, Charles L. Remington; March 4, 1948, 16 specimens, H. B. Mills; Eckert's Cave, Monroe County, Illinois, January 27, 1947, 2 specimens, B. D. Burks and L. J. Stannard. In the collection of the Illinois Natural History Survey.

The subgenus *Tritomurus*, discussed critically by Bonet (1931), is the extreme trogolophile representative in the subfamily Tomocerinae. Pigmentation is reduced, eyes are absent, and there are other characters which accompany these changes. Four widely separated species are recognized by Gisin (1944) up to the present time: *T. scutellatus* Frauenfeld, from European caves, *T. suzukaensis* Yosii from Japan, and *T. californicus* Folsom and *T. oregonensis* Denis from North America. According to the same authority, *T. macrocephalus* Kolenati (1858) does not belong to this Order. Two other species, *T. terrestralis* Stach (1922) and *T. ruigadoensis* Yosii (1939) have been referred to this genus by their authors. Both of these species have or approach a full *Tomocerus* number of eyes (6 + 6; Yosii states "Eyes eight on either side . . . " but in his figure he shows only 5!).

Tomocerus and *Tritomurus* are separated by Folsom (1913) by the presence or absence of eyes and a clavate tenent hair, and the possession of a one- or two-segmented tibiotarsus. Handschin (1929) considers only blindness and the presence or absence of a typical tenent hair in separating the species groups. Gisin (1944) separates the genera only on the presence or absence of eyes, and follows Bonet in reducing *Tritomurus* to subgeneric standing. What all of this amounts to is that we are here considering two species groups which at their extremities certainly may merit generic distinction. As species approach in these complexes, as is illustrated by Stach's *terrestralis*, Yosii's *ruigadoensis*, and Bonet's *vasconicus*, we find overlapping of "generic" characters until some commonly used are valueless as absolute criteria.

It is possible that Denis' surmise that *Tritomurus* is a polyphyletic group is correct. Nevertheless, the use of this name, as well as *Pogon-*

ognathellus, furnishes a convenient division on a subgeneric basis and therefore the species grouping is of value.

Tomocerus (*Tritomurus*) *missus* is readily separated from the other blind forms described in this genus by the slender mucro with a single intermediate tooth, and the obliquely truncate unguiculus bearing a tooth on the inner angle. The tridentate unguis, with the conspicuous teeth rather evenly spaced is also diagnostic. The blind *Tritomurus* forms of the world can be separated by the following key:

1. Mucro without intermediate teeth. Unguiculus lanceolate, with small basal spines..**scutellatus**
   Mucro with intermediate teeth. Unguiculus lanceolate and unarmed or broadly lamellate with inner tooth.................................. 2
2. Unguiculus broadly lamellate, with inner tooth. Unguis strongly tridentate. Mucro with one intermediate tooth.............................**missus**
   Unguiculus not broadly lamellate; if approaching this condition then unguis not tridentate and with more than one intermediate mucronal tooth...... 3
3. Unguis bidentate. Dental spines with four or five in an inner series parallel to the apical spines in the regular series.......................**suzukaensis**
   Without a second apical series of dental spines........................... 4
4. Unguis unidentate...**oregonensis**
   Unguis bi- or tridentate....................................**californicus**

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RESISTANCE OF CULEX QUINQUEFASCIATUS SAY LARVAE AND PUPAE TO EXPERIMENTAL DROUGHT

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Studies on mosquito sex ratios and the resistance of their aquatic stages to desiccation have nearly always been recorded as incidental to life history studies, rearing techniques, etc. Since specific papers on these subjects are scarce an attempt is made to assemble a few of the scattered references.

Resistance of eggs of various species of *Aedes* and *Psorophora* to varying periods and degrees of dryness is well known. Among the numerous papers may be mentioned: MacGregor (1915,1916), Feilding (1919), Dunn (1926), Hearle (1929), Mail (1934), Shannon and Putnam (1934), Taylor (1934), Johnson (1937, 1947), Gebert (1937), Horsfall (1939, 1942), Yates (1945).

Literature relative to resistance of anopheline eggs to desiccation is much more limited. However, as early as 1899 Celli and Casagrandi recorded that *Anopheles* larvae hatched from eggs which had been dry for two days. Christophers and Stephens (1900), James and Liston (1904), James and Christophers (1909) have all recorded instances of *Anopheles* eggs laid on damp mud hatching upon addition of water. In spite of these pioneer observations this phase of anopheline bionomics has been neglected until quite recently. Many of the recent publications based on field observations in the South Pacific mention drought resistance. Among these are Belkin (1945) and Perry (1946). Thompson (1945) in Sierra Leone considered resistance of *gambiae* and *melas* eggs. All of the above are based primarily on field observations and we know of no quantitative laboratory data.

Likewise, resistance of *Anopheles* larvae and pupae was mentioned by several of the early workers: Celli and Casagrandi (1899), Howard (1900), Nuttal and Shipley (1901), Howard, Dyar, and Knab (1912). Hinman (1938) remarked upon resistance of *Anopheles quadrimaculatus* larvae to dryness after the draw down of the T. V. A. reservoirs. The aforementioned observers in the South Pacific have introduced the problem anew. The only quantitative data based upon experimentation for any *Anopheles* that we know of are those of Schoof et al (1945) for *quadrimaculatus* and those of Bick and Penn (1947) for *walkeri*.

Publications concerning resistance of various culicine larvae and pupae to desiccation include: Macfie (1914), Fielding (1919), Alcock (1921), Peryassú (1922), Young (1922), Headlee (1945). The only quantitative data based on experiment concern *A. aegypti*. We have seen no work which specifically considers resistance to desiccation of the larval or pupal stages of any species of *Culex*.

Data on the sex ratio of recently emerged anopheline adult populations are scanty. Bradley (1926) conducted extensive investigations on *A.*

quadrimaculatus, *A. punctipennis*, *A. crucians* and summarized previous work for the genus. His results and those of the following for various species are controversial and apparently permit of no generalizations: Rees (1901), Ross (1911), Van Breemen (1920) Nuttal and Shipley (1902), Harold (1923), Russell (1925), Keener (1945).

Data given by Young (1922), Shannon and Putnam (1934) and Penn (1947) for two species of *Aedes* all indicate a preponderance of males in recently emerged populations.

A previous study (Bick and Penn, 1947) considered resistance of *Anopheles walkeri* Theobald, *Aedes vexans* (Meigen) and *Wyeomyia smithii* (Coquillett) larvae to experimental drought. These species showed considerable variation in their survival when subjected to certain definite intervals of experimental drought and each species survived strikingly long periods without free water. However, the experimental material was not followed through either until emergence or until death of all larvae so that the effect of the drought on actual adult production was not determined. This paper considers resistance of *Culex quinquefasciatus* Say to various periods of experimental drought and its effect on the number of adults produced.

Culex quinquefasciatus breeds quite generally in small shallow collections of polluted water such as back yard puddles, stagnant ditches, etc. It would be expected that, during almost any season, periods of drought would probably result in the removal of standing water from such habitats and their reduction to a damp mud condition. Subsequently, even a slight rainfall would flood such limited areas. It seems that any container provided with filter paper from which all visible free water has been removed would correspond to the damp mud condition. The addition of water to a depth of ¼" to ½" would duplicate natural conditions which follow a slight rainfall. The present experimental study attempts to simulate the natural wet and damp conditions under which, it appears, *C. quinquefasciatus* may often survive.

METHODS

All larvae and pupae were obtained from three collections: (1) polluted side pools at Davidson's Creek, 1.5 miles northwest of Oxford, Mississippi, October 4, 1947; (2) side pool of polluted creek draining golf course at University of Mississippi, October 18, 1947; (3) same location as (2), November 1, 1947.

The collections were immediately taken to the laboratory and the experiments run at room temperatures averaging 70°F. Only these recently caught and lively fourth instar larvae and pupae were used.

Each larva in a drop of water from the collection source, was introduced into a container provided with filter paper or with paper toweling to fit. The larvae were distributed in covered petri dishes or in large glass covered, enamel pans in the following manner:

Hours Dry	No. in Petri Dishes	No. in Large Pans	Total Used
24	4 dishes, 15 each 1 dish of 17	1 pan of 100	177
48	5 dishes, 15 each	1 pan of 100	175
72	6 dishes, 15 each	1 pan of 100	190
96	8 dishes, 15 each	2 pans, 100 each	320

Petri dishes were used to obtain accurate quantitative data and to facilitate observations as to the stage of development at time of death. Large pans were used to obtain large scale supplemental data. Conditions in petri dishes and in pans were not the same. The water-holding capacity of the filter paper (in petri dishes) was greater than that of the toweling (in the pans). Head space in every pan was considerably greater than in the petri dishes and the number of larvae per unit of surface was not the same. Moreover three different pans not of standard size were used. Hence all general conclusions are based on results from larvae in petri dishes. Data from the pans are considered only as supplemental.

Water was removed by tilting and shaking each container until all visible free water was gone. Groups of larvae were kept on the moist filter paper for 24, 48, 72, and 96 hours. Following these drought periods each container was flooded with water from the collection source and thereafter examined daily. During each examination the number of survivors (and the stage each had reached) was recorded, the progress toward pupation at the time of death observed, and all dead individuals removed.

Pupal resistance was determined by introducing various numbers of recently caught lively individuals into petri dishes or pans and then removing all visible free water as for the larvae. These pupal containers were not flooded. Adult production was recorded daily and the observations continued until all had emerged or were unsuccessful in transformation.

The total number of males and females produced from experimental and from control containers of pupae was recorded. Sex ratios resulting from stock containers of pupae not used in the experiments were also recorded. These data are included along with information on pupal resistance.

RESULTS

Initial larval survival (*Table I*).—Some larvae survived every interval of drought tested: 80% (24 hours), 37% (48 hours), 10% (72 hours), 5% (96 hours). But a comparison between expected survival, based on controls, and survival in the experimental dishes show that increasing intervals of drought resulted in a marked increase in the per cent reduction in survival of larvae. Thus the reduction for 24 hours of drought was 17%, for 48 hours 60%, for 72 hours 89% and for 96 hours 95%. It is clear that any drought period in excess of 24 hours materially reduces the number of surviving larvae.

Microscopic examination of 202 dead individuals following the drought showed that 64% exhibited a humped thorax or pupal respiratory trumpets or both, indicating that internal changes preliminary to pupation were well advanced. Twenty nine per cent died as true larvae. Seven per cent produced apparently fully formed pupae under drought conditions but all were dead when first observed.

Deaths under control conditions were of course limited. However, conditions at death did not parallel the experimental material and there was no evidence that a pre pupal period is critical under normal conditions. Of the controls 20% died as prepupae, 40% as larvae, and

40% as pupae. It seems that the cause of death is not due solely to a lack of free water but to its lack at the critical period when internal changes preparatory to pupation are well advanced. These observations agree in general with those previously recorded for *Aedes vexans* with the exception that a larger number of *Culex quinquefasciatus* were successful in pupation under drought conditions.

Adult production (*Table II*).—Adults were produced under flood conditions following every interval of drought tested. 47% of the original larvae produced adults after 24 hours of drought, 17% after 48 hours, 3% after 72 hours, and 0.8% after 96 hours. But a comparison between expected adult production based on controls and the

TABLE I

SURVIVAL OF LARVAE IMMEDIATELY FOLLOWING DROUGHT

Collection date	Container	Hours dry	No. used	Expected survival based on control	Number surviving	Per cent surviving	Per cent reduction due to drought
10/18	Petri dish	24	77	75	62	80.5	17.3
18/18	Pan	24	100	....	87	87.0	....
10/18	Petri dish	48	75	71	28	37.3	60.5
10/18	Pan	48	100	....	11	11.0	....
10/18	Petri dish	72	90	85	9	10.0	89.4
10/18	Pan	72	100	....	3	3.0	....
11/1	Petri dish	96	120	114	6	5.0	94.7
11/1	Pan	96	200	....	0	0.0	....

CONTROL

Container	No. used	Per cent surviving 24 hours	Per cent surviving 48 hours	Per cent surviving 72 hours	Per cent surviving 96 hours
Petri dishes	44	98	95	95	95

adult production in the experimental dishes shows that the drought probably so weakened the larvae that even for the 24 hour sample the adult population was reduced 45%. For longer intervals the reduction was much more striking. A reduction of 79% was recorded after 48 hours, a reduction of 96% after 72 hours, and a reduction of 99% after 96 hours.

It was originally thought that sufficient material would be available to determine the minimum drought interval causing the death of all larvae. However, rain and cold weather ruined the sources of material after November 1 when the effects of 96 hours of drought were determined. Yet the fact that the 96 hour interval resulted in a 99% reduction in number of adults shows quite clearly that this is the prac-

tical maximum drought period which the species can survive and produce adults.

As stated previously, experiments in large pans were designed to supplement data from the petri dishes. In general, initial survival and adult production in pans followed a pattern similar to that in petri dishes, i.e., there was a decrease in survival and adult production with increasing intervals of drought. However, data from petri dishes and pans differed as follows: the per cent larvae surviving the 24 hour drought and the per cent which produced adults were both greater for the pans than for the petri dishes. In contrast, survival and adult production were considerably greater in the petri dishes for all longer drought intervals. It seems that the petri dishes provided the more

TABLE II

ADULT PRODUCTION, DROUGHT FOLLOWED BY FLOOD

Collection date	Container	Hours dry	No. used	Expected number of adults based on control	Number of adults	Per cent adults	Per cent reduction due to drought
10/18	Petri dish	24	77	65	36	46.7	44.6
10/18	Pan	24	100	....	67	67.0	....
10/18	Petri dish	48	75	63	13	17 3	79 3
10/18	Pan	48	100	. ...	6	6.0	... .
10/18	Petri dish	72	90	76	3	3.3	96.0
10/18	Pan	72	100	. ...	0	0.0	. ...
11/1	Petri dish	96	120	101	1	0.8	99.0
11, 1	Pan	96	200	....	0	0 0	. ...

CONTROL

Total used	Total number of adults	Per cent adults
44	37	84

favorable habitat but that the differences were not manifest in the 24 hour sample.

Pupal survival and sex ratio (*Table III*).—Of 298 pupae subjected to the drought 98% produced adults. There was only one death before transformation was well under way. Of 123 control pupae 99% produced adults. In the previous study an adult production of 94% for *Aedes vexans* pupae was recorded under similar drought conditions. These results have convinced the author that placing pupae on damp filter paper is an excellent technique for obtaining large numbers of adults in perfect condition since the usual tendency for many adults to fall into the water and die, or at least to become worthless for further study is eliminated.

Sex was recorded for 414 adults resulting from experimental and from control pupae. Pupae under drought conditions gave a male: female ratio of 1.0: 1.1. The controls gave a ratio of 1.2: 1.0. However there was no consistent correlation among ratios obtained from the various samples of experimental pupae, nor among ratios obtained from the various samples of control pupae. It seems that the above ratios may be combined to represent approximately the correct ratio (1.0: 1.0) for these experiments since pupal mortality was negligible in either case and since observations were continued with a known number of pupae until all had either died or produced adults.

In addition adults produced in two stock containers representing two collections were sexed before all had emerged. Results were as

TABLE III

PUPAL RESISTANCE AND SEX RATIOS

Collection date	Container	Condition	No. used	No. males produced	No. females produced	Male:female	Per cent emerging
10/4	Petri dish	Drought	97	51	42	1.2 : 1.0	95.8[1]
10/4	Pan	Drought	100	38	61	1.0 : 1.6	99.0[2]
10/18	Pan	Drought	101	51	49	1.0 : 1.0	99.0[3]
		Totals	298	140	152	1.0 : 1.1	97.9
10/4	Petri dish	Wet	25	10	15	1.0 : 1.5	100[4]
10/18	Pan	Wet	98	58	39	1 4 : 1.0	99.0
		Totals	123	68	54	1.2 : 1.0	99.1
	Total (Wet and dry)		421	208	206	1.0 : 1.0	98.3

[1]One dead pupa.
Three incompletely emerged.
[2]One individual not accounted for.
[3]One incompletely emerged.
[4]One incompletely emerged.

follows: collected October 18, 124 males, 92 females (1.3: 1.0); collected November 1, 168 males, 125 females (1.3: 1.0). Since a few surviving larvae and pupae remained in the containers when the adults were sexed, these latter ratios can not be considered absolute. The quite general tendency of male mosquitoes to emerge earlier undoubtedly accounts for the higher male production in the stock containers.

DISCUSSION

Bick and Penn (1947) showed that fourth instar larvae of *Aedes vexans, Anopheles walkeri,* and *Wyeomyia smithii* all resisted 96 hours or more of continuous experimental drought. *Culex quinquefasciatus* also survived this interval but it resulted in a 95% reduction in the

number of survivors. Based on the maximum number of hours of drought which each can survive, representatives of these genera may be rated as follows: *Wyeomyia smithii* (192 hours), *Anopheles walkeri* (120 hours), *Aedes vexans* (96 hours), *Culex quinquefasciatus* (96 hours).

But regardless of initial survival, the present study shows that the drought apparently so weakened the larvae that even a 24 hour interval resulted in a 45% reduction of the adult population and that for 96 hours a 99% reduction was effected. Clearly, 96 hours may be taken as the maximum drought interval for *Culex quinquefasciatus*.

Russell (1925) reared isolated pupae in individual test tubes with 1-2" of water and reported the following mortality: *Anopheles quadrimaculatus*—46.3%, *An. punctipennis*—27.2%, *An. crucians*—23.5%. Crowell (1940) reported 7% pupal mortality in massive colony rearings of *An. quadrimaculatus* under flood conditions. In contrast *C. quinquefasciatus* pupae subjected to drought showed but a 2% mortality and Bick and Penn (1947) found a 6% mortality for pupae of *A. vexans*. These results demonstrate the practical importance of including in routine control operations all depressions which have been reduced to the damp mud stage. The ease in obtaining a large number of adults in perfect condition from pupae placed on slightly damp filter paper warrants advocating this procedure in rearing techniques.

Based on 94% emergence, Bick and Penn (1947) reported a male: female ratio for *A. vexans* of 1: 1.6. The present study shows that *C. quinquefasciatus* with an emergence rate of practically 100% yielded a male:female ratio of 1:1.

SUMMARY

1. Larvae of *Culex quinquefasciatus* were subjected to controlled drought in the laboratory. 362 mature larvae were kept on damp filter paper in covered petri dishes for 24, 48, 72, 96 hour intervals after which they were flooded to determine survival and thereafter were observed daily to determine adult emergence.

2. Some larvae survived every interval tested. The drought resulted in a reduction of surviving larvae as follows: 24 hours (17%), 48 hours (60%), 72 hours (89%), 96 hours (95%). Any drought period exceeding 24 hours materially reduced the number of surviving larvae.

3. At least one adult was produced under flood conditions subsequent to every interval of drought tested. The drought resulted in a reduction of adults as follows: 24 hours (45%), 48 hours (79%), 72 hours (96%), 96 hours (99%).

4. In another series of experiments, 292 adults (98%) were produced from 298 pupae maintained under continuous drought.

5. The 421 adults which emerged from the pupal experiments were sexed. 208 were males, 206 females, a ratio of 1.0: 1.0. For all practical purposes the ratio obtained from experimental and from control pupae was the same.

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SBORNÍK NÁRODNÍHO MUSEA V PRAZE (ACTA MUSEI NATIONALIS PRAGAE).

We have received ten numbers devoted to Zoology, apparently all that have been published in that field. Of these, eight are entomological, seven dealing with the Coleoptera and one with the Embiidina. Volume I B contains four zoological numbers, all published in 1938; volume II B contains three, all published in 1940; and volume III B contains three, all published in 1947. One short paper is in the Czech language, with a Latin summary; the others, except for an introduction or summary, are in Latin, French, or German. All papers are taxonomic. The most important are *Monographische Studien über die bulgarischen Embiidinen*, by Karel Táborsky; *Etudes sur les espèces du genre Anthaxia Eschsch. (Col. Bupr.)*, by Jan Obenberger; *Ad regionis palearcticae Buprestidarum cognitionem additamenta*, by Jan Obenberger; and *Additamenta ad cognitionem specierum generis Phytodecta Kirby*, by Jan Bechyne.—M. T. J.

A SUPPLEMENT TO "KEY TO KNOWN PUPAE OF THE GENUS CALENDRA, WITH HOST-PLANT AND DISTRIBUTION NOTES"[1]

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Under "Description of Pupae," p. 147, insert the following description to precede *C. inaequalis* (Say).

Calendra mormon (Chttn.)

Rostrum with six seta-bearing tubercles only, basal pair on or not on prominences. Wrinkles sometimes present and almost identical about the bases of basal and second tubercles; sometimes smooth or less rough about basals than about second tubercles; meso- and metanotal setae lacking; setae of eighth tergite usually absent; prolatero-pronotal setae usually, and medio- and spiraculo-pronotal setae regularly, lacking.

Female.—Length, 11.65 mm., pronotal width, 3.11 mm. Rostrum with six conical, seta-bearing tubercles without basal prominences; wrinkles about bases of basal and second tubercles almost identical, less prominent than on apical three-fourths; rostrum reaches tips of protibiae. Prolatero-pronotal setae four; setae of eighth tergite six, apically multipointed. A fairly prominent conical projection without seta near annus, each side.

Description from a pupa which yielded an adult. Length, 10.51 to 13.28 mm., average (10), 11.63 mm.; pronotal width, 2.74 to 3.59 mm., average 3.07 mm.

This species may key to "y" on page 161 or to "e'" on page 162, depending on whether the basal tubercles appear to be on prominences or merely a wrinkled plane.

On page 161, before "Length" in line "z" insert "Mesonotal setae two or more," and in line "zz" insert "Mesonotal setae lacking."

Under "zz," insert "j'" and "jj'" as follows:

j'. Spiraculo-pronotal setae present. Length 7.81 to 8.25 mm., average (2), 8.03 mm.; pronotal width, 2.78 to 2.98 mm., average 2.88 mm. (See notes under "oo") .... **C. inaequalis**

jj'. Spiraculo-pronotal setae lacking. Length, 10.51 to 13.28 mm., average (10), 11.63 mm.; pronotal width, 2.74 by 3.59 mm., average 3.07 mm. Develops in *Scirpus occidentalis* (S. Watts) Chase. Occurs in Ariz., Calif., Idaho, Nev., Oreg., Utah, Wash., Wyo., and Alberta and British Columbia .... **C. mormon**

On page 162, before "Total length" in line "f'" insert "Four rostral tubercles," and in line "ff'" insert "Six rostral tubercles."

[1]Satterthwait, A. F. 1931. Ent. Soc. Amer. Ann., 24: 143–172, illus.

Under "ff'," insert "k'" and "kk'" as follows:

k'. Prolatero-pronotal setae present. (Measurements, distribution, and host-plants as under "ff," page 162) . . **C. venatus**
kk'. Prolatero-pronotal setae lacking. (See notes under "jj'" **C. mormon**

On page 151, insert the following description to precede *C. costipennis* (Horn).

Calendra multilineata Satht.

Rostrum with six conical, seta-bearing tubercles, the basals on broad, irregular, deeply wrinkled areas. Mesonotal setae lacking. Prolatero- and postlatero-pronotal setae four each, medio-pronotals, two; mesonotal setae lacking; metanotals, two. Setae of eighth tergite lacking.

Female.—Length, 12.66 mm., pronotal width, 3.19 mm. Rostrum with six conical, seta-bearing tubercles, the basals, and to a lesser degree the middle tubercles, on broad, irregular areas with one fold nearly as high as the basal tubercles; the paired tubercles equally spaced on rostrum, but those of third pair closer together than those of basal and median pairs; rostrum long, slender, reaching beyond protibiae. Prolatero-pronotal setae widely separated, the inner setae near the middle of the front margin of pronotal disc, the outer near the edges and as near to the medio-pronotals as to the inner prolatero-pronotals; medio-pronotals and postlatreo-pronotals normally placed, the outer postlatero-pronotals quite small; spiraculo-pronotals lacking or tiny; mesonotals none; metanotals two.

Description from a reared pupa. Length, 11.90 to 12 66 mm., average (2), 12.28 mm.; pronotal width, 3.19 to 3.23 mm.; average, 3.21 mm.

This species keys to "r," only. On page 160, change "r" and add "r'" and "rr'" to read:

r. Sides or prominences not overhanging.
r'. Mesonotal setae lacking. Length, 11.90 to 12.66 mm., average (2), 12.28 mm. Develops in *Scirpus occidentalis* (S. Wats.) Chase. Occurs in Ill , Ind., Mich., Nebr., Tex., Utah, and Wis., **C. multilineata**
rr'. Mesonotal setae usually four or more, rarely two.

On page 163, insert before "*Calendra inaequalis*," the paragraph:

Calendra mormon, Mormon Billbug.

Scirpus occidentalis (S. Wats.) Chase, Viscid Great Bulrush.

On page 164, under "*Calendra robusta*," and following "*Scirpus validus*," add "*Scirpus occidentalis*."

On page 164, following the paragraph for "*Calendra robusta*," add the paragraph:

Calendra multilineata, Many-lined Billbug.

Scirpus occidentalis.

On page 168, following the paragraph on "*Scirpus validus*," insert the paragraph:

Scirpus occidentalis, Viscid Great Bulrush.

Calendra mormon. *Calendra robusta*. *Calendra multilineata*.

A NEW SPECIES OF PELOCORIS FROM NEVADA, WITH NOTES ON THE GENUS IN THE UNITED STATES
(Hemiptera: Naucoridae)

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University of California,
Berkeley

Family NAUCORIDAE Fallen 1814
Subfamily Naucorinae (Stål) 1876
Genus Pelocoris Stål 1876

Pelocoris shoshone sp. nov.

Dorsum bicolored, head and pronotum yellowish, hemelytra and abdomen black, sides yellowish. Under surface: legs yellowish, most of remainder somewhat darker, except propleuron, which is yellowish; mesosternum black, bordered laterally by yellow. Size: 8–9 mm. long, 5 mm. wide.

Head.—3.25 mm. wide (including eyes), 2 mm. long; yellow, smooth and glistening, a median line of faint, yellow-brown mottling beginning in anterior quarter and extending to pronotal margin, where it expands to a triangle; as long as wide between eyes (77::78); eyes closer anteriorly than posteriorly (55::70), inner margin curved laterad; antennae 3-segmented, pilose; labrum yellow, smooth, evenly rounded at free edge; mouth parts yellow, reddening at tip; eyes reddish-yellow.

Pronotum.—smooth, glistening, yellowish, posterior border darker; 4.5 mm. wide posteriorly, 3 mm. anteriorly; 2 mm. long medially, 2.5 laterally (135::85 and 60::75, respectively); surface minutely reticulate under strong power; propleura yellow, darker on posterior and internal margins; scutellum blackish, conspicuously tipped with yellow.

Hemelytra.—blackish, embolia white, contrasting with the deeply infuscated remainder; abdominal dorsum beneath wings velvet-black, fading to brown, then yellow on borders; golden pile conspicuous laterally; abdominal venter conspicuously pilose, brownish, each segment yellow at margin.

Legs.—Prolegs with coxae prominent, elongate; two small clusters of reddish-brown, short spinules on interno-anterior margin, one cluster proximad, the other distad; a small cluster of similar spinules distad on interno-posterior margin; femora characteristically swollen and globular, bearing the narrow, attenuated tibiae which fit into grooves on the anterior edge of the femora; tarsi reduced to one segment, forming the points of the tibiae. Mesolegs with coxae semi-prominent, much smaller than procoxae, margined and pilose exteriorly; femora yellow, polished, narrow and linear, flattened dorso-ventrally; anterior margin smoothly rounded, with a few scattered reddish spinules, posterior margin flattened, ridged dorsally and ventrally, each ridge bearing

conspicuous, short, reddish spinules and short golden pile; apical tip of femur with a comb of short, reddish spinules above tibial junction, the above-mentioned posterior ridge spinules likewise forming dense combs at the tip; tibiae cylindrical, glistening-yellowish, conspicuously armed with long, reddish spines, among which are set smaller spines, arranged, but not markedly so, in lines along the length of tibia; two denser combs of spines arm the tibial apex; tibial dorsum bearing a mat of thin, long, yellow hairs extending most of the tibial length; tarsi yellowish, 2-segmented, the segments about equal-sized, linear-cylindrical, edged with two rows of small, reddish spinules below; a mat of long, thin, yellow hairs on upper surface; last segment dark at tip, bearing the two long, yellowish, simple tarsal claws, darker at base and apices. Metalegs generally similar to mesolegs, except that posterior femoral margins bear no short yellow pile, only short reddish spinules; femora more robust, terminal comb of spines lacking, except for two closely set spinules; tibiae similar to mesotibiae, but much longer, yellow mat much more conspicuous; tarsi as described for mesolegs, but longer.

Genitalia.—See fig. 1.

Type locality.—NEVADA, Lincoln County (Ash Warm Springs in Pahranagat Valley, 24(I)40, el. 3800 ft. -LaR).

Types.—Holotype (No. 5906) and allotype (No. 5907) in the collection of the California Academy of Sciences. Paratypes in the collections of the U.S. National Museum, British Museum (Natural History), Clemson College, Dr. R.L. Usinger, Dr. H.B. Hungerford, Harry P. Chandler and the writer. The type series consists of 19 specimens, 14 males and 5 females.

Pelocoris shoshone represents a remarkable westward extension of the generic range in the United States, no member of the genus being known previously west of the Rockies. This is the only new addition to our fauna since Torre-Bueno described *P. carolinensis* from some of the late C.S. Brimley's North Carolina specimens 40 years ago. Previous to the discovery of the new species, the designations "Pelocoris" and "Ambrysus" were tantamount to "East" and "West" when considered in the light of the geographics of United States naucorids.

P. femoratus (Palisot-Beauvois) 1805 ranges over the entire United States East of the Rockies. I have seen specimens in the Usinger collection from KANSAS (*Coldwater*, 12(IV)26, -Beamer & Bare), OHIO (*Hebron*, 10(VI)16, A.J. Basinger), NEW YORK (*White Plains*, -J.R. Torre-Bueno), NEW JERSEY (*Riverton*, 17(VIII)02, E.P. Van Duzee), FLORIDA (*Dunedin*, (IV)25,-W.S. Blatchley), SOUTH CAROLINA (*Graniteville*, 25(X)30 and *Myrtle Beach*, 3(VII)30, -D. Dunavan), MISSISSIPPI (*Charleston*, 10(IX)26, -H.M. Harris), LOUISIANA (*Slidell*, 14(IX)30, -H.M. Harris). I have also seen other South Carolina specimens, from various localities (D. Dunavan), in the Clemson College collection.

As even a casual perusal of the above-mentioned specimens immediately shows, what we call *P. femoratus* in this country is either a widely variable entity, or several very closely related units as yet insufficiently known to be satisfactorily separated. As Dr. Usinger has pointed out in conversation, for example, the Dunedin specimens are quite easily

separable, as a unit, from the Coldwater individuals. A final solution of this phase of the problem will require a great many more specimens from intermediate localities than are now available, and my concern with *femoratus* material as now understood has been solely that of providing comparative notes for the new species.

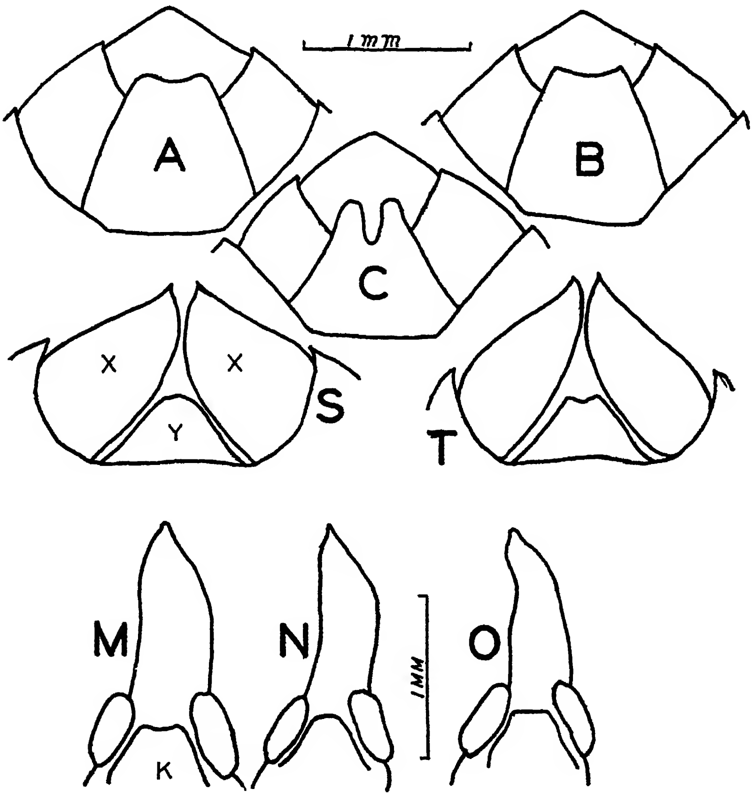

FIG.1. A, female subgenital plate (ventral aspect) of *P. shoshone*, allotype. B, female subgenital plate of *P. femoratus*, Coldwater, Kansas. C, female subgenital plate of *P. carolinensis*, metatopotype. S, female abdominal tip (dorsal aspect) of *P. carolinensis*, metatopotype; the same figure will also serve for *P. shoshone*, allotype. T, female abdominal tip of *P. femoratus*, Coldwater, Kansas. M, male aedeagus of *P. femoratus*, Coldwater, Kansas (*k*, basal aedeagal plate). N, male aedeagus of *P. shoshone*, holotype. O, male aedeagus of *P. carolinensis*, metatopotype.

P. carolinensis Bueno 1907, was

"Described from 8 males and 8 females taken by Mr. C. S. Brimley, at Lake Ellis, Havelock, N. C., and two carded specimens from Blanfort, S. C., in the American Museum of Natural History collections. Types in U. S. National Museum (♂ and ♀), American Museum of Natural History (two carded specimens mentioned above), collection of C. S. Brimley (♂ and ♀), and my collection.

"This bug differs from the species recognized as *Pelocoris femoratus* Pal.,

Beauv., in its smaller size, more slender shape, the cleft female genital segment, the more densely punctate and stouter prothorax, and the more noticeably flattened prothoracic margins." (Torre-Bueno, 1907.)

Dr. Hungerford (1919, 1927) has recorded the species from a single Kansas locality, in the latter paper giving an excellent, detailed account of the life history of his specimens. His opening paragraph is of interest: "The above-named bug" (*P. carolinensis*) "is the only representative of the family Naucoridae reported from Kansas. It has been taken several times from some pools near Coldwater, Kansas, but has not been found elsewhere in the state. I have previously reported the first collection which consisted of a long series of this insect taken by Mr. Beamer and his entomological survey party on July 28, 1916". His efforts to establish the species in the vicinity of Lawrence, some 300 miles northerly from Coldwater, were unfruitful.

I have seen specimens in the Usinger collection from the type locality, Lake Ellis, N.C., a male with a red type label, and a female compared with the types, and so stated in Torre-Bueno's handwriting. I was further privileged to see additional Lake Ellis specimens, as well as one from Southern Pines, N.C., all in the collection of the N.C. Department of Agriculture, and found two males and two females among a lot sent me from Clemson College, three being from Pontiac and the other from Bethune, S.C. In certain structural characters, *P. carolinensis* is the most strikingly distinct of our three species, and I am inclined to believe it occurs only along the Atlantic Coast. Dr. Hungerford's Coldwater specimens, from my examination of the dozen-or-so examples in the Usinger collection, are clearly *P. femoratus*. The southernmost record I know is the following excerpt from Torre-Bueno (1915), written of a specimen in the Harris collection: "*Naucoris poeyi* No. 148, 'Florida, Doubleday' is *Pelocoris carolinensis* Bueno, characteristic"

P. shoshone differs externally most markedly from *P. femoratus* and *P. carolinensis* in its possession of a blackish, abruptly yellow-tipped scutellum, black area down the median line of the prosternum, black dorsum of the abdominal segments, and marked robustness of the legs. This latter difference may be more concretely specified in proportionate ratios:

	Ratio of metatibial width to length		Ratio of metatarsal width to length
P. shoshone	1 : : 9	*P. shoshone*	1 : : 7
P. femoratus *P. carolinensis*	1 : : 11	*P. femoratus* *P. carolinensis*	1 : : 10

The following key will differentiate the three species:

1. Female subgenital plate deeply notched at apex, emargination at least twice as deep as wide; male dorsal aedeagal plate abruptly truncate at tip; Atlantic Coastal.......................................**carolinensis**
   Female subgenital plate only weakly emarginate; male aedeagal plate rounded or weakly emarginate.. 2
2. Female dorsal terminal abdominal plate distinctly notched at tip; male aedeagal plate emarginate at tip; U. S. east of Rockies...........**femoratus**
   Female dorsal plate rounded at apex; male plate rounded at apex; Nevada, **shoshone**

The *Pelocoris biimpressus* of Montandon (1898), said to be from "North America", is unknown to me. Hungerford wrote of it in 1919: "Montandon and Champion both mention this as a variety of the species *Pelocoris femorata*, as set forth in the key. Stal says it is from North America". In his key, it is differentiated from *P. femoratus* by the following couplet:

"B. A dark streak on embolium, scutellum dark.............. **P. biimpressus**
BB. Not as above.................................... ....**P. femoratus**"

I have few biologic notes on *P. shoshone*. Ash Warm Springs, the type locality, varied in temperature from 36°C to 32°C in the area within which the type series was collected. The warmest water was that issuing directly from the seven springs which served as the source of the water, augmented by several spots along the main channel bottom from which water could be seen entering the channel. The springs lay close to the foot of a small hill, and each gave rise to a short stream which entered the main channel—a winding, even-sided and flat-bottomed streamcourse, thickly lined with algae, but otherwise clear and unimpeded. Ten side streams entered the main channel a few yards downstream from the springs. The total length of the main waterbody is some 100 yards, and maximum width somewhere near 15 feet, although most of the major portion lies between 8-10 feet. It is much favored locally as a swimming pool, and only near the source-springs was much vegetation, exclusive of algae, noticed growing. Unlike Dr. Hungerford's experience with his Coldwater specimens, I found *P. shoshone* markedly mild-tempered, and never noticed any inclination to bite; furthermore, the owner of the pools, who has seen the entire "swimming" population of the valley come-and-go many times during his tenure, could not remember a single complaint against any aquatics except notonectids, although naucords were perhaps the most abundant animals there.

I am indebted to a number of people for many of the specimens utilized in this report. I would like to thank Dr. R.L. Usinger for free access to his extensive series of *Pelocoris*, and for criticism of the manuscript. Mr. D.L. Wray, of the North Carolina Department of Agriculture's Division of Entomology, generously sent specimens of *P. carolinensis* from the type locality for examination, while Dr. O.L. Cartwright was kind enough to let me see all the *Pelocoris* in the Clemson College collection.

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✓ A TEXTBOOK OF ENTOMOLOGY, by Herbert H. Ross. John Wiley and Sons, Inc., New York, and Chapman and Hall, Limited, London. ix+532 pages, 434 figures. 1948. Price, $6.00.

The publishers have kept their promise to give us something new in the way of a general entomology text. At the same time, its use will not mean a radical departure from the way in which the beginning course is conducted. The text merely attempts to present a well-balanced treatment of the subject, in which taxonomy is given a reasonable place in relation to insect biology, and in which suitable space is devoted to the newer developments in the fields of physiology and insect control.

Dr. Ross attempts to emphasize principles throughout the work. This is evident in the very readable introductory chapter on the history of entomology (pp. 1–25), in his discussion of insect palaeontology (pp. 425–445), and in the parts devoted to insect ecology (pp. 446–482) and control (pp. 482–515). The chapter on insect physiology (pp. 119–171), which follows those on external (pp. 58-99) and internal (pp. 100–118) morphology, is designed to present the matter, in one place, by function rather than by structure.

Two hundred and six pages are devoted to taxonomy. A rather conservative classification is used, but there are certain departures from systems commonly employed, for example, in the placing of the Collembola in a separate subclass of Insecta, the Oligoentoma, and in the reduction of the Strepsiptera to a suborder of the Coleoptera. As a whole, the presentation of the subject is lucid. The student is not introduced to a bewildering array of families; the most important families, or in many cases superfamilies, are included, particularly in the treatment of the major orders, but most of the smaller orders are treated without consideration of their subdivisions.

The original illustrations are for the most part well executed and the borrowed ones well selected. Exceptions to this are few. Some minor errors, inaccuracies, and instances in which a different arrangement or choice of material might have been made, occur, but it is practically impossible to publish a first edition which is entirely free from such. This text should find wide usage in beginning courses in general entomology.—M. T. J.

A RATIO HYPOTHESIS PERTAINING TO THE BIOLOGICAL ACTION OF POISONS AND DRUGS

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U. S. Department of Agriculture, Agricultural Research Administration, Bureau of Entomology and Plant Quarantine

In a previous publication (3) a working hypothesis was presented to explain the relationship found to exist between the concentration of administered poison and the survival time of insects injected with sodium metarsenite. This hypothesis, which will be referred to here as the "ratio hypothesis," was stated briefly in a generalized form and at greater length in a mathematical form. The physicochemical interpretation of the data rested upon an assumed variable ionization of the arsenite within the range of concentrations used. The purpose of the present paper is to state the generalized form of the ratio hypothesis more precisely, to distinguish between this hypothesis and any physicochemical interpretation that may be associated with it, and to accept as more likely for sodium metarsenite another tentative interpretation which is based upon degree of ionization of the arsenious acid produced by hydrolysis rather than upon degree of ionization of the sodium metarsenite.[2]

The following definitions and discussion are necessary for an understanding of the concise statement of the ratio hypothesis that will be given below:

Let z represent a drug or a poison that has been administered to an organism or applied to some other physicochemical system. The method of administration is immaterial and, in the case of an organism, may be oral, by application to body surface, by inhalation, or by injection into the body fluid or tissues.

Let x and y represent either two different chemical species or the proportions in which a single chemical species is affected by two different conditions of restraint. Thus x and y may be the chemical forms (as

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[2]The authors are grateful to Adrien Albert, of the Wellcome Research Institution, London, England, for pointing out that these results would be in greater accord with the more modern concepts regarding electrolytic solutions and with the results of Hoskins (1), if the postulate were made that the arsenious acid molecule, formed by hydrolysis, were the toxic chemical species in the insect poisoned with sodium metarsenite. The authors also appreciate the kindness of Sterling B. Hendricks, Bureau of Plant Industry, Soils, and Agricultural Engineering, and Walter J. Hamer, National Bureau of Standards, in discussing this paper with them.

molecules and ions) in which z is considered to exist in solution within the blood and tissue fluids of the organism, or x may be the number of molecules (or ions) affected by one condition and y the number affected by another condition of restraint; in either case $z = x + y$. The assumption is made that x, but not y, is the form or condition in which z is toxic to the organism. Let c_x and c_y be the respective concentrations of x and y, and let c be the total concentration of z; then $c = c_x + c_y$.

If x and y are different chemical species, they are assumed to be components of an equilibrium which is such that, if some x is removed

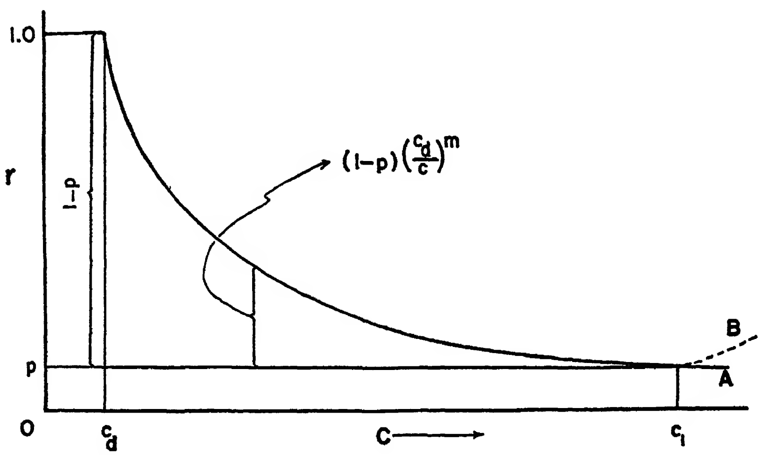

FIGURE 1. A hypothetical c, r curve, showing that the ordinate may consist of parts p and $(1-p)\left(\frac{cd}{c}\right)^m$ and that $(1-p)\left(\frac{cd}{c}\right)^m$ may vary between $1-p$ and 0 as c varies between c_d and a concentration c_l that within experimental error corresponds to $r = p$. Mathematically, the curve is treated as though it approaches p asymptotically (curve A), although the point p, c_l may be at a minimum as in the curve B. On the horizontal axis values of c increase in the direction of the arrow. The value of r varies from 0 to 1.0.

from the solution, some y will change into x, thereby maintaining the value of an equilibrium constant. If x and y are the proportions of z under two different conditions of restraint, I and II, respectively, these conditions of restraint are assumed to be so related that an increase or decrease in I (and hence in c_x) will result in an equivalent decrease or increase in II (and hence in c_y), and vice versa. In either case the relationship between c_x and c_y may be symbolized by $x \leftrightarrows y$. The equibilibrium is considered to be such that, as the concentration c decreases regularly, the ratio $\frac{c_x}{c} = r$ increases regularly from a minimum

$\frac{c_x}{c} = p$ up to a maximum $\frac{c_x}{c} = \frac{c_d}{c} = 1$. The relationship between the ratio r and the concentration c is represented by a c, r curve of the type shown in figure 1.

As indicated by figure 1, $\frac{c_x}{c}$ is the sum of a constant part, p, of the ordinate, and of the other part which varies inversely with c; i.e., $\frac{c_x}{c} = p + \left(\frac{c_x}{c} - p\right)$. As c decreases, $\frac{c_x}{c} - p$ rises toward its maximum of $\frac{c_d}{c} - p = 1\text{-}p$, with velocity and acceleration that is determined by the factor $\left(\frac{c_d}{c}\right)^m$; thus the variable part of the ordinate that lies above the level of p, is $(1 - p)\left(\frac{c_d}{c}\right)^m$. The variable portion of $\frac{c_x}{c}$ is less than $1 - p$ when $c > c_d$, but equals $1 - p$ when $c \leq c_d$; $\frac{c_d}{c}$ may not exceed unity, for c_x may not exceed $c_x + c_y$ and can equal $c_x + c_y$ only when $c_y = 0$. It follows that $\frac{c_x}{c} = p + (1 - p)\left(\frac{c_d}{c}\right)^m$ and that

$c_x = cp + c\,(1 - p)\left(\frac{c_d}{c}\right)$; and when $c \leq c_d$, $c_y = 0$ and $c_x = c$.

By "inflection" is meant a region of irregularity, perhaps associated with a discontinuity, such as has been found in concentration-survival time curves and in curves of the concentration-per cent mortality type or, more generally expressed, in concentration-time of effect curves (figure 2) and in concentration-degree of effect curves (figure 3). Figure 2 represents a concentration-survival time curve with a region of inflection the lower limit of which projects on the concentration axis at c_d. In this paper a concentration-time of effect curve will be referred to as a c, t curve and a concentration-degree of effect curve as a c, s curve.

By "physicochemical system" is meant either (1) functioning protoplasm in contact with blood, tissue fluid, or an artificial fluid substituted for these, or (2) a nonliving system (an enzyme system, for example) capable of showing a reaction to the action of a poison or drug.

The ratio hypothesis now may be stated concisely as follows: If, in a physicochemical system, $z = x + y$, in accordance with the equilibrium $x \rightleftarrows y$ such that $\frac{c_x}{c} = r$ increases regularly from a minimum, p, toward a maximum, 1, as c regularly decreases, and if r approaches its maximum

with sufficient acceleration; it is possible for inflections to occur in the corresponding c, t and c, s curves.

Whether or not a curve obtained experimentally will exhibit an inflection when the conditions of the ratio hypothesis are fulfilled will

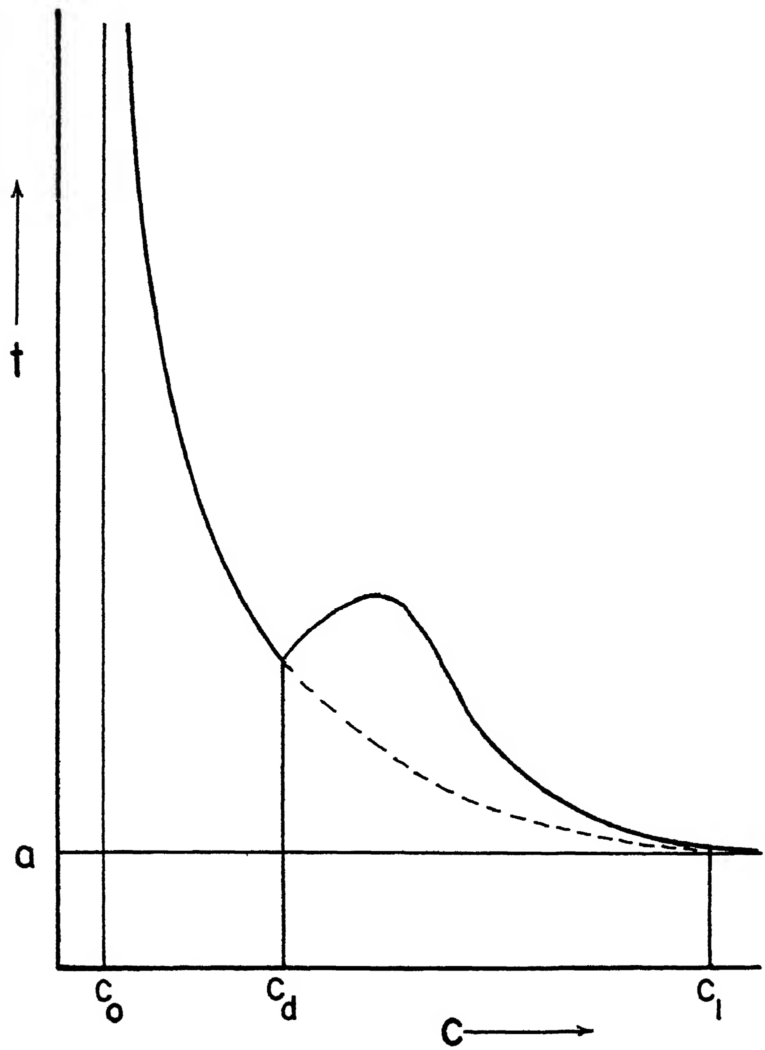

FIGURE 2. A hypothetical c, t curve, which approaches a and c_o asymptotically; c_d and c_l correspond to c_d and c_l in figure 1. The broken line corresponds to the condition that $z = x$ throughout the concentration range. Arrows indicate the directions of increasing concentration and time of effect (for example, survival time).

depend upon several other conditions, among which are the following: (1) The experimental errors must be small enough not to obscure the inflection or, conversely, the inflection must be sufficiently large. (2) The experimental points that represent the c, t or c, s curve must be sufficiently numerous and near enough together in the region of the inflection to delineate the inflection. (3) The critical concentration c_d must fall within the range of concentrations used experimentally and must be so far removed from asymptotic extremities of the c, t

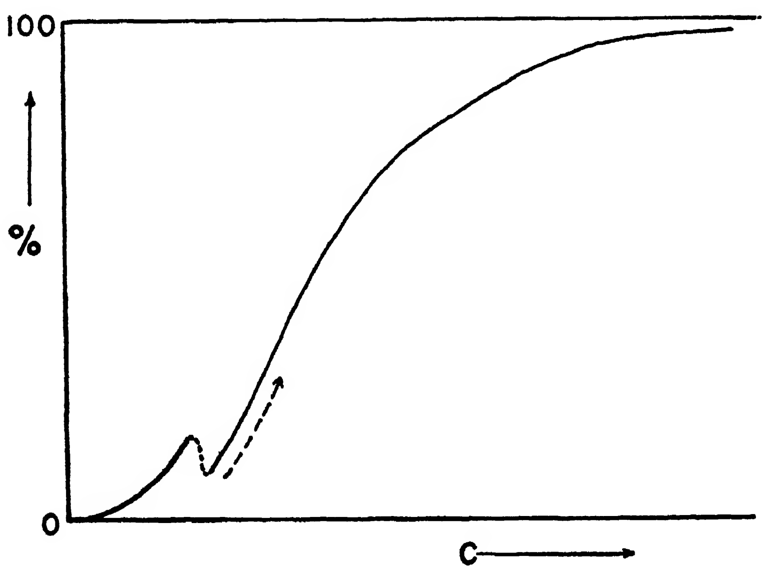

FIGURE 3. A hypothetical sigmoid c, s curve of the percentage-mortality type. The broken line indicates the region of inflection and arrows indicate the direction of increasing values of c and of s, which in the figure is represented as per cent. This curve corresponds to a given value of t. The inflection may move up the curve in the direction of the broken arrow as t increases.

curve and from the extremities of the c, s curve that the inflection will be unobscured by the larger errors at those extremities.

The ratio hypothesis is of sufficient generality to apply to different physicochemical situations. It would apply, for example, if y should represent molecules of a poison and x toxic ions formed from them by a variable degree of ionization in accordance with the law of mass action. It would be applicable in case the pharmacological or toxic effect were to involve only a molecular or only an ionic species of the drug or poison, provided that the activity of the chemical species varied with concentration in accordance with the hypothesis, in which instance

c_x would represent the concentration of the species that was active and c_y the concentration of the species not active; here the conditions of restraint would be those implied by the physicochemical concept of "activity." It would apply also if molecules of undissociated poison were to compete with a metabolite for combination with a particular enzyme, in which instance x would be that proportion of the molecules that successfully combine and y the proportion prevented by the metabolite from combining with the enzyme. The hypothesis would apply also in case the toxic effect of a poison were correlated with the degree of hydrolysis of the y form of the poison, x representing the form after hydrolysis, provided that the degree of hydrolysis varied in accordance with the conditions of the hypothesis.

The ratio hypothesis alone offers no means of identifying x and y either as particular chemical species or as particular conditions of restraint but, in conjunction with an inflection or discontinuity of the kind specified, it does suggest that the involved poison or drug does exist in an effective (x) and a noneffective (y) chemical form or as a single species subject to two different conditions of restraint (I and II).

In the authors' previous paper (3), reporting results obtained by injecting sodium metarsenite into roaches, it was shown that the ratio hypothesis can be used as a basis for obtaining calculated survival times that agree well with those obtained experimentally and that this hypothesis serves to explain the appearance of the inflection found in the c, t curves. The physicochemical interpretation tentatively offered was that the arsenite ion formed by ionization of the sodium metarsenite, or something dependent upon the arsenite ion, was the toxic chemical species (x), whereas the sodium metarsenite molecule (y) was nontoxic. But according to the more recent concepts of physical chemistry, within the concentration range used the sodium metarsenite must be considered to be completely ionized. Disregarding possible interpretations based on activity, competition, etc., complete ionization of the sodium metarsenite necessitates the discarding of the interpretation that rests upon an assumed incomplete or variable ionization in favor of a more likely but still tentative one based upon a hydrolysis equilibrium. According to this hydrolysis interpretation, (1) sodium metarsenite exists in solution only as sodium ions and arsenite ions, no molecules of sodium metarsenite being present; (2) at and below the critical concentration, c_d, all the arsenite ions or a constant proportion of them in buffered body fluid are hydrolyzed into molecules of arsenious acid that ionize to a slight degree but above c_d, as concentration increases in a less buffered or unbuffered body fluid, the proportion hydrolyzed and unionized decreases to a minimum value, p; and (3) the arsenite-

ions are considered to be the nontoxic form (y) of the poison and the arsenious acid molecules the toxic form (x). This interpretation is in line with one given by Hoskins (1) relative to the penetration of sodium arsenite through the insect integument. The authors' results and those of Hoskins are in agreement regardless of which physicochemical interpretation is preferred, provided that the same interpretation is applied to both sets of results. On the other hand, the two sets of results are not necessarily in disagreement when one set is interpreted on the basis of a variable ionization or activity and the other set on the basis of hydrolysis, for then it becomes a question of whether the equilibrium $x \rightleftarrows y$ and the effective chemical species, x, are the same for penetration through the integument as for toxic action in the tissues.

The hydrolysis interpretation does not change the character of the mathematical analysis and the curve fitting reported earlier (2, 3, 4). It means merely that the equilibrium $x \rightleftarrows y$ is interpreted as a hydrolysis rather than as an ionization equilibrium, and that y is considered to be arsenite ions rather than molecules of sodium arsenite and x arsenious acid molecules rather than arsenite ions.

This amplified statement of the ratio hypothesis and this tentative physicochemical reinterpretation are presented with the hope they may be of aid in the discovery of general principles pertaining to the mode of action of drugs and poisons in biological systems.

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A NEW APHID ON DEVIL SHOE STRING (TEPHROSIA VIRGINIANA, L. PERS.)[1]

CLYDE F. SMITH,
Raleigh, North Carolina

Neoamphorophora tephrosiae, new species

It has been difficult to place this species. It does not fit in any of the described genera but I do not feel the differences justify the erection of a new genus. The general characters of this species are suggestive of *Neoamphorophora* Mason, but it differs from *Neoamphorophora* in lacking a distinct media in the hind wing. However, some of the specimens have the media indicated by a short stub (fig. 1). The majority have neither the media nor the cubitus indicated. Because of the apparently unstable condition of the veins of the hind wing the writer believes *tephrosiae* fits best in the genus *Neoamphorophora*. Material of *tephrosiae* differs from *Microparsus* Patch in having the cornicles swollen rather than subcylindrical.

Alate vivipara.—Color of living material amber to reddish brown; cleared material shows the coloration characteristically fuscous to piceous on all segments of the antennae (except basal one-tenth of III which is pale), on distal one-half to two-thirds of all femora, on distal and proximal one-third to all tibiae (the middle portion of the tibiae is light), and on all of the cornicles, cauda and anal plate. Cubitus and 1st anal vein of fore wing dusky. Remainder of body and appendages pale to slightly dusky.

Measurements: length of body 1.70 to 2.00; width of head through eyes 0.48–0.52; antennal III, 0.75 to 0.90; IV, 0.68 to 0.78; V, 0.55 to 0.69; VI, 0.16 to 0.20 plus 1.00 to 1.34; rostum attaining second coxae; rostral IV plus V, 0.13 to 0.14; hind tibiae 1.88 to 2.05; hind tarsi 0.13 to 0.14; cornicles 0.47 to 0.51; cauda 0.35 to 0.41.

Antennal III with 15 to 23 sensoria; of 42 antennae 1 had 15, 2 had 16, 6 had 17, 6 had 18, 8 had 19, 7 had 20, 7 had 21, 4 had 22, and 1 had 23 sensoria on antennal III. Antennal IV with 1 to 14 sensoria; of 41 antennae 1 had 1, 1 had 2, 3 had 3, 2 had 4, 2 had 5, 1 had 6, 4 had 7, 3 had 8, 5 had 9, 3 had 10, 4 had 11, 6 had 12, 4 had 13, and 2 had 14 sensoria on antennal IV. Antennal V without secondary sensoria. It is interesting to note that the 1943 material averaged fewer sensoria than the 1941 material; in 1941 antennal III had 16 to 23 sensoria and IV had 8 to 14; in 1943 antennal III had 15 to 21 and IV had 1 to 11 sensoria. Antennal hairs short and inconspicuous, distinctly shorter than diameter of antennal segment.

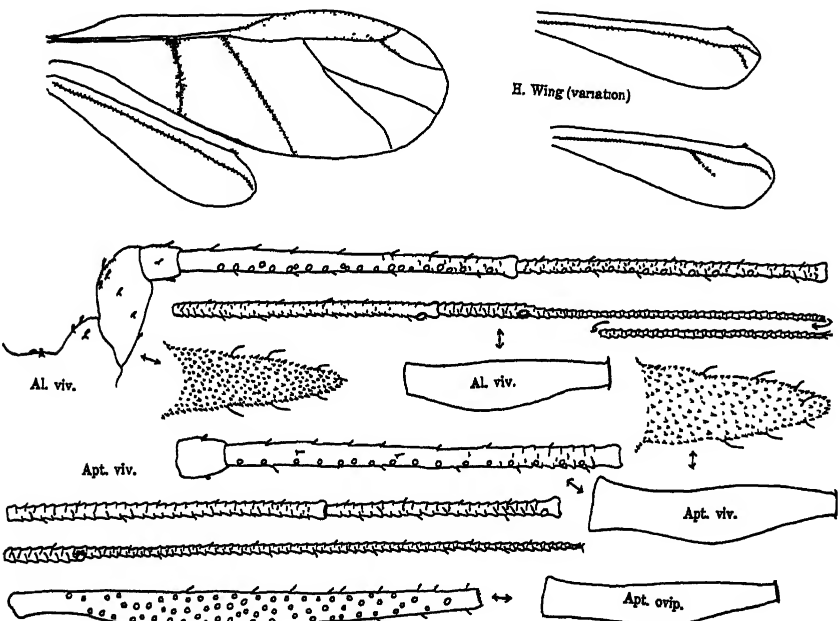
Cubitus and media of hind wing usually absent. However, the cubitus may be indicated by a short stub on an occasional specimen and the media may be indicated in the same manner or by a branching (?)

[1]Research Contribution No. 2, published with the aid of the State College Research Fund, Department of Zoology, North Carolina State College of Agriculture and Engineering of the University of North Carolina.

of the radial sector near the tip of the wing. The media of the fore wing is once branched. The 1st anal and cubitus are heavily bordered with fuscous. Cornicles distinctly swollen. Cauda bearing 3 pairs of lateral hairs and 1 dorsal hair.

Apterous vivipara.—Color of living material amber to reddish brown. Cleared material shows the same characteristic coloration as the alate.

Measurements: Length of body 2.30 to 2.70; width of head through eyes 0.52 to 0.55; antennal III, 0.92 to 0.96; IV, 0.71 to 0.83; V, 0.55 to 0.66; VI, 0.18 to 0.20 plus 1.00 to 1.12; rostrum attaining second coxae; rostral IV plus V, 0.13 to 0.14; hind tibiae 2.00 to 2.14; hind tarsi 0.13 to 0.14; cornicles 0.45 to 0.56; cauda 0.45 to 0.60.



Neoamphrophora tephrosiae Smith

Antennal III with 8 to 21 sensoria; of 38 antennae 1 had 8, 2 had 11, 1 had 12, 4 had 13, 3 had 14, 8 had 15, 4 had 16, 5 had 17, 4 had 18, 4 had 19, 1 had 20, and 1 had 21 sensoria on antennal III. Antennals IV and V without secondary sensoria. Antennal hairs short and inconspicuous, distinctly shorter than diameter of antennal segment. Cornicles distinctly swollen. Cauda with 3 pairs of lateral hairs and 1 dorsal hair.

Apterous ovipara.—Color of living and cleared material similar to that of the alate vivipara.

Measurements: Length of body 1.5 to 2; width of head through eyes 0.45 to 0.51; antennal III, 0.79 to 0.91; IV, 0.65 to 0.70; V, 0.49 to

0.60; VI, 0.14 to 0.18 plus 1.00 to 1.2; rostral IV plus V, 0.12; hind tibiae 1.7 to 1.95; hind tarsi 0.12; cornicle 0.50 to 0.55; cauda 0.50.

Antennal III with 12 to 16 sensoria; of 15 antennae 3 had 12, 4 had 13, 5 had 14, 2 had 15, and 1 had 16 sensoria on antennal III; antennals IV and V without secondary sensoria.

Alate male.—Color of living and cleared material similar to that of the alate vivipara.

Measurements: Length of body 1.10; antennal III, 0.70; IV, 0.61; V, 0.51; VI, 0.17 plus 1.08 hind tibiae 1.65; hind tarsi 0.10; cornicle 0.31; cauda 0.22.

Antennal III with approximately 33 sensoria, antennal IV, 29 and antennal V, 14.

Types.—Holotype and allotype slides to be deposited in the U. S. National Museum; paracotype and paratype slides in the writer's collection.

Type locality.—Five miles south-west of Danbury, N. C.

Collections.—On *Tephrosia virgininiana* (L) Pers., five miles south-west of Danbury, N. C., May 14, 1941. holotype slide (2 alates and 1 aptera) and 8 paracotype slides (18 alates and 20 aptera); July 29, 1941, 1 paratype slide (1 alate and 5 aptera); October 7, 1941, allotype (1 male, 3 ovipara, and 1 apterous vivipara), and 3 paratype slides (2 aptera and 11 ovipara); June 10, 1943, 12 paratype slides (9 alate and 35 aptera).

At the time of the first collection, May 14, 1941, three adjacent clumps of plants were heavily infested with aphids, most of which were apterous. None of the other bunches of *Tephrosia* were infested. On July 29 the aphids had spread to two other adjacent plants and were also present on the plants on which they had been observed on May 14; however, the aphids were quite scarce on July 29. On October 14, 1941, oviparous forms were found on all the clumps of *Tephrosia* in the vicinity, but the aphids were not very abundant on any of the plants.

When abundant, this species of aphid causes considerable stunting of the plants.

THE FEEDING ORGANS OF ARACHNIDA, INCLUDING MITES AND TICKS, by R. E. SNODGRASS. Smithsonian Misc. Coll., Vol. 110, No. 10; 93 pages, 29 figures. August 18, 1948.

This is obviously a continuation of Mr. Snodgrass' studies of the mouth parts of arthropods of medical importance, begun during the war with a publication in 1943 of a similar study of the mouth parts of biting and disease-carrying flies. It is a broadly comparative study of the mouth parts of arachnids, with special sections devoted to the Palpigradi (Microthelyphonida), Solpugida, Pedipalpida, Ricinulei, Chelonethida (Pseudoscorpionida), Scorpionida, Phalangida (Opiliones), Araneida, and particularly the Acarina, which take up more than one-third of the text (34 pages). This work represents another of Mr. Snodgrass' valuable contributions to the field of arthropod morphology.—M. T. J.

MIMICRY BETWEEN THE DRONE-FLY, ERISTALIS TENAX (L.), AND THE HONEYBEE, APIS MELLIFERA L. ITS SIGNIFICANCE IN ANCIENT MYTHOLOGY AND PRESENT-DAY THOUGHT[1]

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Excepting the silkworm and the honeybee, there is probably no insect that can show an historical record equal to that of the Drone-fly, *Eristalis tenax* (L).

Because of the mimicry existing between the Drone-fly and the honey-bee many erroneous superstitions and myths have come to us down through the ages. For nearly three thousand years a superstition has been prevalent in the minds of the masses, as well as in the writings of the learned, to the effect that besides the usual production of honey-bees in hives, they originated by spontaneous generation from the carcasses of dead animals, and principally from those of oxen.

Among the many myths that have grown up around the honeybee that of the *Bugonia*[2] will be considered the most fully because it shows how entomology may throw light on questions that have puzzled and distracted the learned, as well as the layman, for centuries.

The myth evidently started in Egypt and appears in a distorted form in the writings of the Hebrews, in which, however, it is a dead lion in which Sampson finds the honey-comb (Book of Judges, xiv, 8). With Sampson it seems that "on the way through the vineyards of Timnath Sampson had killed a lion, and after a while, on his way to fetch his bride, he turned aside to see the carcass of the lion; and behold there was a swarm of bees in the mouth of the lion, and honey; and he took it into his hands, and went on, eating as he went".

In the Greek and Roman literature references to the *Bugonia* are abundant and the myth becomes more elaborate. An old poet, Eumelus, about the eighth century before Christ, allegedly wrote a poem called *Bugonia.* From Virgil (*Georgics*, iv, verses 281–559) we find the myth of Aristaeus, the demigod, benefactor of mankind, who taught men to hunt and to keep bees. The substance of this story is that Aristaeus once lost his hives by famine and disease. In his distress he applied to his mother; and through her intervention and that of the sea-god Proteus, he was initiated into the mystic rite by which a swarm of bees was produced from a slaughtered ox. Egypt, during the Ptolemies, seems to have been the center of this superstition. The reason alleged

[1]Contribution number 280 from the laboratories of the Department of Entomology, University of Illinois.

[2]The word *Bugonia* arose in Greece and means ox-progeny, as well as the expressions *bugines melissae* and *tauriginae apes*, that is, oxen-born bees, in the Greek and Latin literature respectively.

for this experiment in burying an ox in such a way as to get bees was that the annual inundation of the Nile often destroyed the beehives and rendered the renewal of bees necessary.

Varro (116–27 B. C.), the most learned of the Romans and a contemporary of Cicero, in his book on Agriculture said that "from this rottenness the sweetest bees are born, the mothers of honey . . . the bees are produced partly from hives, partly from the bodies of rotten oxen". Ovid (43 B. C.–17 A. D.) wrote a verse on the *Bugonia* also. The naturalist Pliny (23–79 A. D.) said "when bees are lost they can be reproduced from the fresh intestines of oxen, buried in dung". Mago, quoted by Columella, teaches that the pouch alone of the ox is sufficient for the production of bees. Many others later repeated the same tale, changing it here and there as they saw fit.

A recipe for producing bees from dead carcasses which was supposed to have been practiced in Egypt was to bury an ox with its horns projecting, through which, after they were cut off, the bees would emerge. Another recipe, the most elaborate of them all, can be traced down to Florentinus, an obscure writer, in the *Geoponica*[3]. There is an old Syric translation of the *Geoponica,* which may have been the channel through which the notion of the *Bugonia* spread eastwards, which gives an account of the process that was used by the King of Mauritania, Juba, from a colony in what is now known as French West Africa: "Build a house ten cubits high, with all the sides of equal dimensions, with one door and four windows, one on each side; put an ox into it, thirty months old, very fat and fleshy and chosen in the spring when the sun is in the sign of the bull; let a number of young men kill him by beating him violently with clubs, so as to mangle both flesh and bones but taking care not to shed any blood; let all of the orifices, mouth, eyes, nose, etc., be stopped up with clean and fine linen, impregnated with pitch—precautions to prevent the ox's vitality from escaping so that it may be conserved for the generation of the swarm of bees; let a quantity of thyme be strewed under the reclining animal, and then let the windows and doors be closed and covered with a thick coating of clay, to prevent the access of air or wind. Three weeks later let the house be opened and let the light and fresh air get access to it, except from the side from which the wind blows strongest. After eleven days you will find the house full of bees, hanging together in clusters, and nothing left of the ox but horns, bones, and hair".

The belief in the *Bugonia*, like any other myth, grew and developed, and there was much shifting around about what came from which animal. It was contended that the "king", or what we call the "queen-bee", was produced from the brain of the ox; the worker bees from its flesh. Others contended, that while bees came from oxen exclusively, wasps originated from asses, drones from horses, and hornets from mules. Thomas Moufet said that the harder flesh of horses produced hornets, the softer flesh, wasps. The Greek commentators of Nicander attribute this faculty not to the flesh but to the skin, the condition being that the horse should have been bitten by a wolf.

[3]The *Geoponica* is a work on agriculture compiled from the old Greek and Roman authors on the same subject.

In the Oriental literature may be found only one instance of the *Bugonia* belief. The Arab traveler Massoudi (died 955 in Cairo) in his *Golden Meadows* relates that in Arabia a man found a hive of bees near the seacoast and upon going there to collect the honey found a heap of bones, more or less rotten, in the cavity of which bees had deposited the honey which he brought back with him.

It appears that of the ancients Aristotle was the only learned man from the European area who did not mention the *Bugonia* in his writings about bees, even though he was a believer in spontaneous generation. He knew that "four-winged insects have the sting in the tail, and the two-winged ones . . . have the sting in the front of the head".

And so this superstition prevailed, besides in Northern Africa and in some parts of Asia, through the Middle Ages, and found expression even in the 16th and 17th centuries. The friend of Luther, the learned and pious Melanchthon, considered it as a divine provision; an Italian poet of the 16th century Giovanni Rucillai (1475–1526) put it again into verse[4]; the naturalist Aldrovandi (1602) accepted it without contradiction[5]; the English naturalist Moufet spoke of it as a common occurrence[6]; and, finally, the learned Samuel Bochart admitted it as an undoubted truth[7].

The original cause of this delusion lies in the fact that the very common fly, scientifically called *Eristalis tenax* (L.), popularly the drone-fly, lays its eggs upon the carcasses of dead animals; that its larvae develop within the putrescent mass, a liquid which collects around such decomposing animals, and finally change into a swarm of flies which in their shape, hairy vestiture and coloration look superficially like honeybees, although they belong to a totally different order of insects. The honeybee belongs to the order Hymenoptera and has four wings; the female is provided with a sting at the end of the body; the fly, *Eristalis tenax*, belongs to the order Diptera, has only two wings, and no sting. Honeybees probably, in a few instances, were found to occupy the dried and bleached skeleton of an ox; perhaps even in the mouth of the skeleton of Sampson's lion or the house as built for the King of Mauritania after elaborate treatment. And probably many did try the experiment and obtain something that looked like a bee; but that there was a second part of the experiment which, if they ever tried it, never succeeded and that was to make that bee-like something produce honey. If they did care much about this failure and did not prosecute the experiment any further, it was probably because, in most cases, they found that it was much easier to procure bees in the ordinary way. This attitude is probably what prompted the various recipes.

There are many citations of this mimicry in the literature, a few of which will follow. Heliogabalus, Roman Emperor (218–222) often sent his friends vessels of "disgusting animals" and often they were filled with numerous flies which he called tame bees, which were undoubtedly *E. tenax*, with which he frightened his friends.

[4]1681, *Le Api*, p. 68.

[5]Aldrovandi, 1602, De animalibus insectis, pp. 58–60.

[6]Moufet, 1634, Theatrum Insectorum.

[7]1663, *Hierozoicon, sive opus bipartitum de animalibus sacrae scripturae*, Vol. 2, pp. 502–507.

Minakata, reporting in "Some Oriental Beliefs about Bees and Wasps", says that" so far as I could find, the people of the Far East seem not to have possessed any belief about oxen-born bees; . . Diptera mistaken for Hymenoptera—Sie Tsái-Kang, in his 'Miscellanies of Five Phenomena' (Japanese edition, 1661, book 9, p 43) narrates thus: 'In Chang-sha I saw honeybees all without stings, so that, when trifled with upon the palms they were quite harmless; having no difference from flies, that was strange!' No doubt he has seen some Drone-flies"

Mr. Byran, "On mimicry in Diptera", said "But it is among the flies of the family Syrphidae that we find the most singular resemblance with Hymenoptera. Who has not seen the ubiquitous Drone-fly (*Eristalis tenax*) buzzing on the window pane or, in late autumn crawling wearily along the sills, and who has not mistaken it for a bee (*Apis mellifera*)? I have but to go into the garden and watch a patch of flowers; there, besides the numerous bees which come to gather honey, I am sure to find some of these flies And I have to look twice before pronouncing them to be flies"

Mr Benton in "Notes on Carniolan Bees, and a peculiar belief among the Beekeepers of Carniola, Austria, regarding the Drone fly, *Eristalis tenax*" calls attention to the fact since the introduction of Italian bees into the southern portion of the country the Carniolan bees have become somewhat yellow on the abdomen, whereas the pure strain is gray. The natives attributed this fact to crossbreeding between the bees and the Drone-fly

In another paper on mimicry, Mr. Benton tells of a photograph which was published in the American Bee-Keeper, *14:* 52, 1904, labeled "bees working on Chrysanthemums." On examination the "bees" turned out to be drone-flies, which have the habit of visiting chrysanthemums to feed on the pollen and the nectar and which are given credit for affecting the fertilization of these flowers.

He also gives another instance where the Drone-flies were mistaken for bees in the famous Utter trial, described in "Gleanings in Bee Culture" for 1900 and 1901, where he presented a case of mounted bees and drone-flies to the jury and to skilled beekeepers, both groups being unable to differentiate them fully.

Brues states that an asilid or robber-fly (probably *Promachus fitchii* O. S.) with a fondness for the honeybee frequently catches the common drone-fly, *Eristalis tenax*, and that this probably means, that to the insect eye *Eristalis* really looks like the honeybee, but this mimicry to the bee is unfortunate to the fly when these asilids are present

The final extinction of this absurd notion among civilized nations was due to two causes: (1) among scientific men, to the confutation of the old belief in spontaneous generation and the general recognition of the principle, *omne vivum ex ovo*, all living beings come from an egg, proclaimed by William Harvey (1651); (2) among the ignorant crowd, to the introduction of a sanitary police which prevented carcasses from lying about and affording the spectacle of bee-like flies swarming about them.

A group of men almost contemporaries, brought about the solution in the 17th century, by dint of observing insects in nature and not merely

compiling authorities as was the custom all over Eurasia during the Middle Ages These men were Goedard (1620–1668), Blankaart, (1688), Swammerdam (1637–1680), all three in Holland; Redi (1626-1697) and Vallisnieri (1661–1730) in Italy, and finally Réaumeur (1683–1757) However, most of these men were held by strict religious convictions and perhaps failed to assert themselves outwardly and it was for Osten Sacken, in 1883, to introduce the first explanation of the *Bugonia*, founded upon a resemblance of this fly to the honeybee

Eristalis tenax (L) is of a duller coloring than most of the species of the family to which it belongs, and because of this fact has a remarkable resemblance to a honeybee So great is this resemblance that even

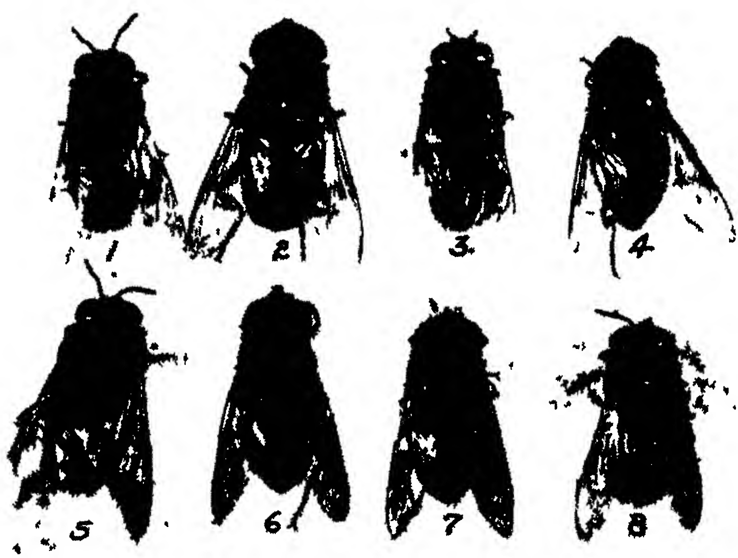

FIG 1 Can you distinguish the flies from the honeybees? Nos 2, 4, 6 and 7 are the drone-fly, *Eristalis tenax;* Nos 1, 3, 5 and 8 are drones of the honeybee, *Apis mellifera* Of the drone-flies, No 2 is a female and the others are males.

trained entomologists often hesitate in order not to get stung. The coloration, the size, the conformation, and the proportions of the different parts of the body of these two insects, belonging to two different orders, are very much alike. The fly keeps its wings more or less divaricated, spread apart posteriorly, whereas the bee keeps the wings above the abdomen, one covering the other at rest, except that in taking nectar and pollen from flowers, it often has its wings divaricated also. Both insects frequent flowers and behave upon them in much the same manner.

The coloring of the honeybee is variable; some varieties having very

distinct brownish-yellow crossbands at their bases. Just the same variations occur in the coloring of the drone-fly.

The drone-fly plays an important role in the fertilization of flowers and of composite flowers especially; in 1893 an attempt was made to utilize this habit to fertilize a non-seeding Chrysanthemum in Jamaica.

The larva of *E. tenax* is the well-known rat-tailed maggot, so called for the first time by Réaumeur. Its long tail is provided with a telescopic arrangement for extending and shortening the breathing apparatus, enabling the larva to live in watery putrescence several inches deep and to breath through the rat-like "tail" tube from the surface.

The larvae live in putrid water, sewers, etc., and crawl out of them to pupate in the vicinity. The vitality of these larvae is extraordinary, hence the name *tenax*, meaning "to hold on", "tenacious".

Eristalis tenax has obtained almost universal distribution and the progress of civilization has only increased its opportunities. In ancient times it had to look for stray carcasses; civilization offers it its drains, canalizations, cesspools, and dungheaps in which it can wallow in abundance and is perhaps better protected against its enemies. Different in this from other insects which disappear with the culture of the land, *E. tenax* thus entered into a kind of commensalism with man and spread in new countries with astounding rapidity. So we see that in its earliest days *E. tenax* appears like a myth, a misunderstood and unnamed animal, praised for qualities which it never possessed, a theme for mythology in prose and poetry. Later on, the bubble of its glory having burst, it gradually settles into a kind of commensalism with man, obtaining from him a local habitation and a name; it joins the Anglo-Saxon race in its immense colonial development, it emulates with it in marvels of fecundity, and at present renders hitherto unrecognized services in converting putrescence into pure and clean living matter.

It is appropriate that this paper should close on the *Bugonia* craze with the moral of it taken from Goethe: "*man sieht nur was man weiss:* man sees only what man knows".

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NOTES ON THE LIFE CYCLE OF THE CHRYSANTHEMUM APHID, MACROSIPHUM SANBORNI (GILLETTE)

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In a genetic study of determination and differentiation of wings in the chrysanthemum aphid, *Macrosiphum sanborni*, several facts were recorded which pertain to the life cycle and natural history of this species. These data are recorded here.

TABLE I

NUMBER OF DAYS FROM BIRTH TO PRODUCTION OF FIRST OFFSPRING

Born	F_1 Produced	Raised at	Number of Days
12–16–46	12–29–46	Room temperature	13
12–18–46	12–30–46	" "	12
12–18–46	12–31–46	" "	13
12–19–46	1– 2–47	" "	14
12–30–46	1–12–47	" "	13
1– 2–47	1–12–47	" "	10
1– 7–47	1–15–47	" "	8
2– 4–47	2–18–47	18° C.	14
2–13–47	2–22–47	" "	9
2–13–47	2–24–47	" "	11
2–15–47	2–23–47	" "	8
2–15–47	2–24–47	" "	9
2–17–47	3– 5–47	" "	16
2–25–47	3– 3–47	" "	6
5– 1–47	5– 9–47	Room temperature	8
5–10–47	5–17–47	" "	7
5–13–47	5–22–47	" "	9
5–13–47	5–26–47	" "	13
10–18–47	10–26–47	" "	8
10–18–47	10–26–47	" "	8
10–18–47	10–26–47	" "	8

Mean 10.33 ± 0.61 days.

Host plant.—All references in the literature which mention host plants state that cultivated chrysanthemums are preferred by this species. Patch (1938) lists five species of *Chrysanthemum* which have been identified as hosts. In the present study all aphids were grown upon cultivated chrysanthemums. The aphids showed a preference for the succulent portions of the plant, and were found in greatest numbers at the tips of the stem and upon the under sides of leaves. Attempts to raise *Macrosiphum sanborni* upon potato plants failed.

Length of generation.—In twenty-one cases observed, the length of time between the birth of an aphid and the time it gave birth to its

first offspring varied from six to sixteen days, with a mean of 10.33 ± 0.61 days. These extremes of variation, 6 and 16 days, occurred among aphids raised at 18° C. in continuous light. Among those raised at room conditions the variation was somewhat less, from 7 to 14 days. The number of days required apparently varies within rather wide limits since in at least one case offspring of the same parent, raised at the same time, varied from nine to thirteen days. The individual cases are shown in table I.

TABLE II

YOUNG PER FEMALE PER DAY REARED AT 18° C. IN CONTINUOUS LIGHT

Experiment Number	Total Young Produced	Parent-days[1]	Young per Female per Day
6–7	141	114	1.236
13	45	60	0 750
14	31	59	0 525
18	183	240	0.762
21	130	160	0.813
24	10	15	0.667
25	65	44	1.477
26	60	67	0.895
27	75	90	0 833
29	1078	583	1.849
30	71	40	1.775
31	25	30	0.833
33	130	140	0.928
34	200	180	1.111
35	206	200	1.030
36	190	200	0 950
37	192	200	0.960
38	170	150	1 133
39	82	90	0 911
40	92	90	1 022
42	165	204	0 808
43	246	304	0.809
44	35	55	0.636
46	79	54	1.463
47	480	682	0.704
48	289	496	0 582
50	118	371	0.318
51	121	132	0.916
Totals	4709	5050	0 953

[1]Parent-days were calculated by multiplying the total number of parents on a plant by the number of days they remained on the plant.

Families raised at 18° C. took on the average 10.42 ± 1.21 days to reach maturity (production of first offspring) while those raised at room temperature (about 23° C.) required 10.28 ± 0.65 days. The calculation of the standard error of the difference between these means indicates a probability of 92 per cent that this difference is only accidental. Possibly the variability of room temperature contributed to the slight shortening of the time required for the aphids to reproduce.

Young per female per day.—Records were kept of the numbers of

females put on each experimental plant, and of the numbers of offspring produced. Parents and offspring were counted daily. Parent-days were calculated by multiplying the number of parents by the number of days they were on the plant. Thus twenty parents on a plant for a total of five days would make a total of one hundred parent-days. Data are available for both sets of conditions, 18° C. in the light and 20° C. in darkness. These data are shown in Tables II and III. Females in 18° in the light produced an average of 0.953 ± 0.062 young per female per day, while those at 20° in the dark averaged 1.295 ± 0.079. The difference between these means (0.342) when compared with the standard error of this difference (0.100) indicates a probability of about

TABLE III

YOUNG PER FEMALE PER DAY REARED AT 20° C. IN THE DARK

Experiment Number	Total Young Produced	Parent-days	Young per Female per Day
11	210	161	1.304
13	91	98	0.928
29	158	142	1 112
30	90	54	1.666
31	16	15	1.066
33	82	56	1 464
34	95	87	1 092
35	165	102	1.617
37	208	135	1.548
38	93	72	1 291
39	245	212	1.155
40	56	175	0 320
42	260	152	1.710
44	298	199	1.497
46	110	70	1.571
47	407	271	1.502
48	246	308	0 798
49	382	246	1.552
50	354	249	1.421
Totals	3566	2804	1.295

9994 chances out of 10,000 that the difference between these means is due to something other than chance. It is very possible that the direct effect of higher temperature is evident here, as shown by the increased number of young per day. The largest number of young known to be born to a single female under these conditions in a twenty-four hour period is five. All results given in this paragraph concerning families raised at 20° C. in the dark, include data from ten days or less after the change into these conditions. When females were left in the dark for longer periods, numbers of offspring dropped sharply.

Immature stages.—There are four nymphal instars. The first moult occurs between two and three days after birth. In thirteen closely observed cases the first instar lasted an average of 56.8 ± 1.91 hours. This figure agrees with the moults of hundreds of other aphids whose

time of birth was known only within twelve hours but which shed for the first time within three days after birth.

The time at which the second ecdysis took place was not as regular as was that of the first. Observed periods varied from 73 to 105 hours after birth, with a mean time of 96.18 ± 4.74 hours. The mean length of the second nymphal instar was 39.90 ± 3.77 hours, or slightly more than one and one-half days.

The third moult varied from 104 to 159 hours after birth, with a mean value of 124.83 ± 3.42 hours. The third instar was of 34.11 ± 1.66 hours, or approximately one and one half days duration, while the final moult took place an average of 169.50 ± 5.56 hours after birth, with the last nymphal instar 44.73 ± 4.35 hours long.

An average of 169.5 hours or about seven days, elapsed between birth and the last moult. About three more days were required before young were produced. See table I for the average length of time between birth and production of young.

Stage at which wings appear.—Wings are first visible as rounded protuberances in the dorsolateral regions of the mesothorax. The raised portions appear swollen and air-filled. These external evidences of wings are generally first seen in the third nymphal instar, although some individuals showed wings earlier, in the late second instar. Usually however, whether an individual was winged or not could not be determined with certainty until after the second moult. This moult, as noted above, took place from four to five days after birth; for the sake of certainty aphids were not classified as wingless until after the eighth day.

The external development of wings is rapid in the third and fourth instars. Metathoracic swellings are soon apparent, and both sets of wings develop as triangular, inflated pads, closely appressed to the dorsolateral surface of the thorax and abdomen. There is no significant change, except in size, in the fourth instar, and at the final moult the adult wings are attained.

While the figures given above are probably reasonably close to the average lengths of time for each instar, it must be emphasized that there was a wide range of variation. Some aphids produced young as soon as seven days after birth, others took as long as fourteen. Since all were raised at room temperatures the reasons for this variation are not clear from the data at hand.

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NEW SPECIES OF TRICHOPTERA

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Recent examination of several collections of Trichoptera have disclosed a number of new and unusual species, six of the most interesting of which are described in this paper. Types of the new species are in the writer's collection at the University of Wyoming.

Orthotrichia instabilis, n. sp.

This, the third species in the genus described from neacrtic North America, is radically different from either *americana* Banks or *cristata* Morton; it is probably most closely related to *cristata*. The shape and size of the clasper, the plate back of the clasper, and the aedeagus will readily distinguish this species.

Length 2–2.5 mm. Sternite of seventh segment with a prominent mesal process covered with dense long scales. Genitalia as in fig. 1. Claspers, from ventral aspect, large, sub-quadrate, apico-lateral corner broadly rounded, mesal margin somewhat irregular and bearing several large setae, baso-mesal surface concave; claspers fused only at extreme base; from lateral aspect apical part of clasper is curved slightly dorsad. Plate back of clasper, from ventral aspect, large, apically extended into two lateral arms each bearing a prominent seta; a certain amount of variation is exhibited in the shape of this plate, the mesal incision may be absent, or deeper than that shown in fig. 1A, but the general shape and size are similar in all specimens examined; seen from lateral aspect the apex is curved slightly ventrad, somewhat hook-like, and a triangular projection is directed ventrad from the mesal surface. Aedeagus, fig. 1B, very long, bearing a short acute filament twisted one and one-half times around structure, apex expanded, elongate.

Holotype, male.—Winter Park, Florida, May 16, 1940, (H. T. Fernald).

Paratypes.—Florida, same data as for holotype, 8 males.

Oxyethira janella, n. sp.

This species bears little resemblance to other described species. It can be identified at once by the long ventral plate bearing a pair of setiferous tubercles at the apex. Color, size, and general characteristics similar to that described for other members of the genus. Length 2.5 mm. Genitalia as in fig. 2. Sternite of seventh segment with an acute prominent mesal process, its distal margin with a deep incision. Lobe of eighth sternite projected caudad nearly one-half length of ninth sternite, fig. 2B, from lateral aspect, fig. 2A, apex broadly rounded and bearing several large setae; dorso-lateral lobes large, extending caudad beyond any other part of segment, apex broadly rounded and bearing a considerable number of setae along margin. Sternite of ninth segment about three times as long as wide, seen from ventral

aspect, fig. 2B, apex with a deep narrow mesal incision; concave from dorsal view; from lateral aspect, fig. 2A, slightly upturned apically and bearing a pair of prominent tubercles near apex, each with four setae; dorsal portion of ninth produced into a pair of long heavily sclerotized rods which extend caudad nearly as far as ventral plate, widely separated at base but converging to an acute, ventrad directed apex. Aedeagus with very wide base, arises in seventh segment, narrowed cylindrical part lies between above mentioned rods and is projected caudad only slightly beyond them, apex divided into a slender subacute process and a shorter more robust process, whole enclosed in a membranous sac.

Holotype, male.—Winter Park, Florida, May 16, 1940, (H. T. Fernald).

Paratype.—New Orleans, Louisiana, October 10, 1945, (D. G. Denning), 1 male.

Oxyethira grisea Betten

Very little is known concerning the distribution of this interesting species, now known to occur in New York, Indiana, Illinois, and Michigan. In the specimen examined the clavate filament of the aedeagus reaches to the apex of the structure. The margin of the small apical process of the aedeagus is minutely serrate.

Michigan: August 5–15, 1947, (J. W. Leonard), 1 male.

Ochrotrichia potomus Denning

This species, which was recently described from southeastern Wyoming, is herein recorded from Oklahoma.

Oklahoma: Nowata, September 20, 1947, light trap, 1 male.

Hydropsyche impula, n. sp.

This species is very closely related to *valanis* Ross, from which it can be separated by its larger more robust size, the apical segment of the clasper which is considerably thickened and apically acute, and the lateral plates of the aedeagus which do not touch and are subtriangular in shape, the entire aedeagus is more robust.

Length 10 mm. Color of forewings reddish brown with light irroration, heaviest in the apical third, apex with several dark brown markings, flagellum of antennae with black markings on the first seven or eight segments, eyes very large. Genitalia as in fig. 3. Tenth segment short, obtuse; deep triangular incision on meson, short setae along margin of groove, fig. 3B; setae along lateral lobe in the approximate form of a circle, fig. 3A. Clasper with basal segment gradually enlarged apically; apical segment with dorsal margin arcuate from lateral view, fig. 3A, mesal margin considerably enlarged when seen from either dorsal or caudal aspect, fig. 3C. Aedeagus, from ventral view, fig. 3D, with lateral plates separated entire length, sub-triangular, lateral margin sinuate; viewed laterally, aedeagus is quite sharply angled, narrowed just beyond the middle and then widened apically, lateral plates flared dorsad almost to a level with remainder.

Holotype, male.—Sunderland, Massachusetts, July 17, 1938, (J. F. Hanson).

Paratype, male.—Same data as for holotype.

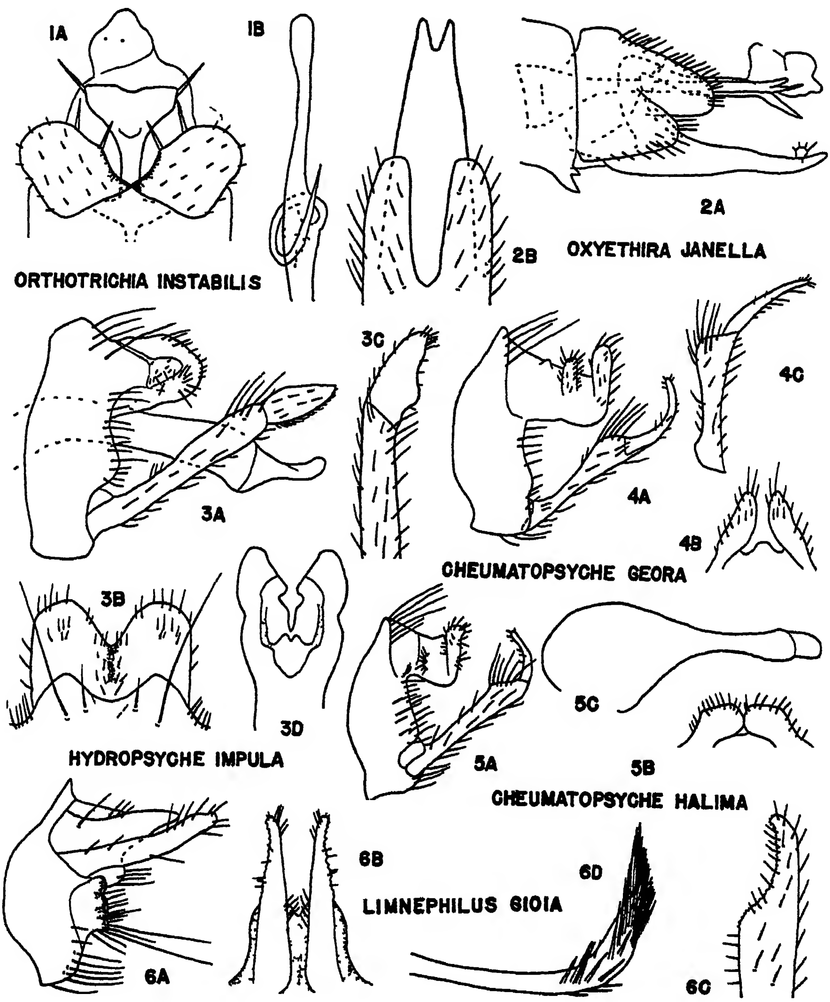

Fig. 1. *Orthotrichia instabilis*, male genitalia: 1A, ventral aspect of ninth and tenth segments; 1B, aedeagus. Fig. 2. *Oxyethira janella*, male genitalia: 2A, lateral aspect; 2B, ventral aspect of ninth and tenth segments. Fig. 3. *Hydropsycha impula*, male genitalia: 3A, lateral aspect; 3B, dorsal aspect of tenth tergite; 3C, caudal aspect of clasper; 3D, ventral aspect of aedeagus. Fig. 4. *Cheumatopsyche geora*, male genitalia: 4A, lateral aspect; 4B, caudal aspect of tenth tergite; 4C, caudal aspect of clasper. Fig. 5. *Cheumatopsyche halima*, male genitalia: 5A, lateral aspect; 5B, caudal aspect of tenth tergite; 5C, lateral aspect of aedeagus. Fig. 6. *Limnephilus gioia*, male genitalia: 6A, lateral aspect; 6B, dorsal aspect of tenth tergite; 6C, dorsal aspect of clasper; 6D, lateral arm of aedeagus.

Cheumatopsyche geora, n. sp.

This species bears closest resemblance to *oxa* Ross, but differs from that species in the very large lateral wart and the thickened apex of the basal segment of the clasper. This species was kindly compared to the type of *oxa* by Dr. H. H. Ross.

Length 7 mm. Wings uniformly brown, appendages about same shade of color. Genitalia as in fig. 4. Tenth tergite longer than deep; apical margin produced into a pair of large dorsally rounded lobes when seen from lateral aspect, sub-acute and widely separated when seen from caudal aspect, fig. 4B, setation sparse; setiferous wart large, about same width throughout and extending dorsad beyond dorsal margin of tergite, cephalad to these lateral tubercoes is a pair of small triangular protuberances which barely project above dorsal margin. Clasper with basal segment short, one and one-half times length of apical segment, apex greatly thickened; apical segment long, slender, curved cephalad when seen from lateral view, slightly convergent from caudal view, fig. 4C, apical segment clothed with minute setae. Aedeagus with basal portion only slightly enlarged, very similar to others in genus.

Holotype, male.—Macon, Georgia, May, 1944, (H. R. Dodge).

Cheumatopsyche halima, n. sp.

This species is very similar to *gracilis* and *gyra*, differing from each in the following characters: dorso-lateral corner of tenth tergite lobes rounded, not produced into an angular projection; tenth tergite shorter and deeper; basal segment of clasper shorter and stockier; apical segment more sharply curved cephalad; aedeagus much more bulbous and more sharply narrowed apically.

Length 7.5 mm. Wings uniformly dark brown. Legs uniformly dark brown, about same color as wings, body slightly darker; head missing on specimen examined. Genitalia as in fig. 5. Ninth segment annular, reduced dorsally to a pair of acute lobes fringed with long setae. Tenth tergite short, only slightly longer than deep; setiferous wart slender, semicircular; lateral lobes extend dorsad beyond remainder, gradually thickened and widened dorsally; from caudal aspect, fig. 5B, apex widened into a somewhat rounded plate, apical margin nearly truncate, mesal margins appressed, inner and outer margins sinuate, setae sparse. Clasper about same length as depth of ninth segment; basal segment not quite three times as long as apical segment, gradually widened to apex, apical segment narrow, curved cephalad; from caudal aspect basal segment straight, apical segments strongly convergent, but do not touch. Aedeagus with basal portion greatly enlarged, apical portion suddenly narrowed; lateral lobes short, ovate, fig. 5C.

Holotype, male.—Amherst, Massachusetts, June 15, 1938, at light, (J. Hanson).

Limnephilus gioia, n. sp.

This species is closely related to *harrimani* Banks from which it can easily be separated by the comparatively short tenth tergite with its wider base, the wider base of the cerci, the lateral arm of the aedeagus and several other details of the genitalia.

Length 11 mm. Wings light brown with irregular dark markings, antennae, palpi and body a trifle darker than wings, legs yellowish. Genitalia as in fig. 6. Tergite of eighth segment with a cushion of short setae. Ninth tergite reduced to a narrow strap, sternite with a short narrow mesal incision. Lobes of tenth tergite slender, long, about two-thirds as long as cerci, acute apically and divergent when viewed dorsally, fig. 6B, outer margin minutely serrate, setae sparse. Cerci from lateral aspect, fig. 6A, long and slender, truncate apically; from dorsal apsect, fig. 6C, base wide, apical part gradually narrowed and convergent, mesal margin serrate and heavily sclerotized. Claspers nearly quadrate, apical margin irregular, bent mesad against caudal surface of segment, ventral corner bearing several long black setae. Mesal part of aedeagus cylindrical, apical portion curved abruptly dorsad, apex with a ventrad directed hook; lateral arms as long as mesal part, apex expanded, apico-lateral margin very thin causing the mesal surface to appear concave, apex bearing a dense mass of stout setae, fig. 6D.

Holotype, male.—Yellowstone Park, Wyoming, Emerald Pool, July 12, 1942, (C. P. Alexander).

NOTICE

"A History of Entomology in Relation to World War II" is now being prepared. Suitable photographs and reprints of published articles dealing with any phase of entomology in connection with the war effort are urgently needed to complete this project. It is requested that persons having such material send it immediately to Emory C. Cushing, General Editor, Route 1, Box 38, Stockdale, Texas. Photographs should be accompanied by appropriate explanation and statement of source.

P. W. OMAN.

ERRATA

The following omission occurred in the index of the March, 1948, issue of the ANNALS:

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THE HOVERING AND MATING OF TABANIDAE: A REVIEW OF THE LITERATURE WITH SOME ORIGINAL OBSERVATIONS

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When the observed mating of *Tabanus nigrovittatus* Macquart was described to Dr. Joseph C. Bequaert, he commented on the scarcity of such reports. This encouraged me to watch particularly for such activity on the saltmarshes of Essex County, Massachusetts, during the summer of 1947. Before reporting my observations, however, it seems desirable to review the known literature on this topic. The records are widely scattered and usually consist of fragmentary notes without any clear index references.[1] Consequently, students of the Tabanidae will doubtless find some omissions. The writer will be most grateful to the reader who calls such items to his attention.

REVIEW OF THE LITERATURE

The statement with which Surcouf (1921a) prefaces his remarks on this subject, "Les Taons s'accouplent dans des conditions généralement inconnues", is still valid. Our present knowledge remains meagre. This summary of reported observations will emphasize how few facts we now possess. These facts, contributed by about a score of workers, furnish a good basis for further investigations. It is hoped that this compilation of data will focus the attention of others on the hovering and mating habits of the Tabanidae.

Europe.—Brauer (1880) was apparently the first to remark on the habits of male Tabanidae. Surcouf (1921a,b) and Bouvier (1945) state that Brauer noted swarms of *Tabanus sudeticus* Zeller mating on the wing in the Tyrolian Alps. On seeking out the exact words of Brauer, we find the following note under this species on the page to which Surcouf alone refers directly (Brauer, 1880, p. 185): "Die Männchen rutteln und schwärmen über den höchsten Bergspitzen vor Sonnenaufgang, z. B. am Dobratsch (Buchmüller) und Hohen Zinken (Frauenfeld) und sitzen an sonnigen Planken des Morgens nach dem Auskriechen; die Weibchen auf Blättern von Gestrauchen und auf Vieh". Here I find

[1]I wish to express my sincere thanks to Dr. Joseph C. Bequaert for his willing, energetic assistance in locating several of the articles herein reviewed.

no mention of mating. Again Surcouf (1921a,b) and Bouvier (1945) report, without reference to any published account, that Régimbart and Moisson saw many matings of an unidentified horsefly take place in air before sunrise on the Esel at an altitude of 2,000 meters in late July, 1905 with the temperature between 5° and 6° C.

Although Verrall (1909) gives no original observations, he says that "Colonel Yerbury informed me that he has seen males of *Haematopota*[2] dancing in small groups in hot sunshine, and he also observed the male of *Therioplectes distinguendus* hovering". In addition, he states (without clear reference) that both Osten Sacken and Schiner mention the hovering of males, a habit which subsequent records confirm and strongly indicate is associated with mating.

The next European to note male activity seems to have been Kirkpatrick (1918), who saw males of *Therioplectes distinguendus* Verrall hovering in large numbers in sunlight over a road from 6:30 to 10:00 a. m. (Greenwich time). Males of *Tabanus bromius* L. were common in the same vicinity but were resting on palings.

Jones (1922), also in England, was chiefly concerned with the "drinking" habits of the males, but it is at least possible that careful observation in such habitats as he describes might lead to the discovery of the mating activities of the nine species reported. These were of four genera, as follows: *Chrysozona*, one species; *Therioplectes*, two; *Tabanus*, three; and *Chrysops*, three.

Just before sunrise on a July morning Surcouf (1921a) observed the mating of *Chrysops caecutiens* L. on the blades of reeds over water. The mating of *C. quadratus* Meigen was later noted under similar conditions (Surcouf, 1921b).

Males of *Chrysozona pluvialis* L. were seen by Goffe (1931) hovering over *Spiraea ulmaria* in the mid-morning sunshine of his British garden. His later article (1935) adds to our knowledge concerning the "drinking" habits of the males of several other species in addition to those mentioned by Jones. Both papers include some information about the food habits of adult males. This is another topic that deserves to be reviewed and to which several of the other papers cited give isolated references.

Cameron (1934) saw a swarm of clegs in full sunlight above a reservoir in Scotland at 11:00 a.m. on a July 19th. He noted that they were exceedingly active and saw pairs meet momentarily and quickly separate. An occasional individual, or perhaps a pair, was seen to leave the swarm and was soon lost to view. This flight lasted for only five minutes, for the flies dispersed when a passing cloud briefly obscured the sun, and they failed to reassemble. Three males were captured from the swarm. At 10:30 a.m. on a July 5th another swarm of *Chrysozona pluvialis* (L.) was seen near enough to the shore of Loch Garten to observe mating on the wing. Specimens of both sexes were taken from this flight.

Bouvier (1945) reported additional observations on European species in Switzerland. He tells of taking many males of *Tabanus sudeticus* Zeller, *T. apricus* Meigen, *T. maculicornis* Zetterstedt and *T. bromius* L. on a warm day between 8:30 and 9:00 a.m. near the source of a stream. They were flying 60 cm. to a meter above the

[2]*Haematopota*= *Chrysozona* (see Goffe, 1931).

ground and were easily netted. None were seen after 10:30 nor on following days. He believes that the males die soon after mating and that mating occurs just after emergence.

The same author once saw several males of *Therioplectes fulvicornis* Meigen hovering like syrphids about 30 cm. from the sod over a damp, sunny Swiss meadow at 11:00 a.m. His descriptive language well expresses their mode of flight and applies as well to the hovering of other species of Tabanidae: "Brusques et rapides crochets, puis l'insecte reprend son vol sur place". He states that the male darts after the female and that mating takes place on the wing. His assertion that the two insects swiftly disappear and rise almost vertically to a great height demands confirmation, however. It is more probable that, as in the instance clearly reported by Philip (1942) and as suggested by the observations of Webb and Wells (1924), Cameron (1934) and others, the pair passes quickly out of sight and shortly after the observer loses track of them they come to rest in nearby vegetation where copulation is consummated.

Africa.—There are a few references to the habits of species from different parts of this continent. Neave (1915) simply notes that both sexes of *Silvius monticola* Neave were abundant in the short grass on the more open parts of the Mlange Plateau of southern Nyasaland. He found them emerging at the time of his visit and many were captured while they were copulating.

Surcouf (1921b) notes that he once saw about 50 males of *Tabanus auropunctatus* Macquart resting on a small stone bridge over a wadi near Rouiba while the females harassed a herd of cattle several hundred meters away. When the herd came to water about 3:00 p.m., nearly all of the males flew towards the females and matings at once took place in air. Three copulating pairs were collected on herbaceous plants at the water's edge.

Surcouf several times saw males of *Tabanus algirus* Macquart flying in different Algerian localities (Rouiba, Fondouck, Belle Fontaine) where the females were emerging. Such males hovered, like *Eristalis* or *Bombylius*, less than a meter above the ground, sometimes only a few centimeters above the cool herbs. At times two or three males hovered over the same spot and, if disturbed, they would make a short, swift turn and come back to the same place to hover against the wind. He watched the emergence of a female. She disengaged herself from the soil and crawled up on a tuft of *Cynodon dactylon* L. where a male seized her. The pair was captured as mating was initiated. In the vineyards of Fondouck, Surcouf also saw males of *Pangonia maculata* Fabricius hovering in uncultivated sections as if awaiting the appearance of females.

Bouvier (1945) noted a large number of *Chrysozona denshami* (Austen) mating on grasses at nightfall in January in the Belgian Congo. Males and females appeared to be in about equal numbers.

Palestine.—Buxton (1924) noted that males of *Chrysozona sewelli* (Austen) hover around the heads of mounted men and their horses while the females are feeding.

North America.—Since the source material is more familiar, this part of the study is, perhaps, more nearly exhaustive. Nevertheless,

it is probably not complete since there are undoubtedly some obscure remarks that have escaped my notice.

Hine (1903) probably made the first recorded observations on an American species in reporting the mating of *Tabanus sulcifrons* Macquart on a rail fence in Ohio. For two successive years he watched pairs copulating on the fence at the south edge of a woods on a clear warm day in mid-August. Mating occurred only between 8:00 and 8:30 a.m. The males of this species clung to the edges of the rails while the females hung limply with legs and wings motionless. If disturbed (Hine, 1906), the males did all of the flying and went but a short distance before alighting. Nine pairs were taken. He states that copulation never lasted more than ten minutes. Two pairs were preserved in formalin and the digestive system of the female was found upon dissection to contain some hardened blood, which yielded haemin crystals when treated with glacial acetic acid. However, there is no real evidence that a blood meal is essential for the maturation of the eggs of Tabanidae. Several authors have expressed the opinion that blood is not necessary and it is known that the females of some species never annoy domestic animals.[3]

Brimley and Sherman (1907) noted that the males of *Hybomitra cincta* (Fabricius) have a habit of hovering in the air in the same manner as the carpenter-bees of the genus *Xylocopa*.

According to Philip (1931), Cameron saw *Tabanus comastes*[4] in copulation at an elevation of 8,500 feet.

The most graphic accounts of hovering are those concerning *Tabanus americanus* Forster in the Florida Everglades as given by Snyder (1917) and by Mosier and Snyder (1918, 1919). They speak of "roaring flights" of "countless thousands" hovering at tree-top height over openings in the forest canopy. This large species swarms from March 10th to May 24th for 15 to 20 minutes from daybreak to sunrise when the weather is reasonably pleasant. They do not hover on rainy nor on unseasonably cool mornings. These authors took less than six hovering flies, all males, in 1918 since the insects are usually too high to permit ready capture. They were sometimes seen to dart towards one another in flight and then cling in pairs. This suggested to the observers that swarming was a mating phenomenon. Mosier was also very sure that they occasionally flew upside down while hovering. On each of four days during the 1919 season a few flies were dramatically brought down from the hovering swarms by H. S. Barber with a 22 calibre pistol loaded with dust shot. The ten specimens so obtained were all males. In 1918 Mosier reported the hovering of about 200 *Tabanus lineola* Fabricius for eight minutes before dark on May 10th at a height of 5 to 8 feet above a road. He knocked down five of them and all were males.

These same papers also give some reports on the flowers that attract the males and females of various species locally. In addition, they contain notes on seasonal distribution and on other matters pertaining to the biology of the Everglade Tabanidae.

In 1924 Webb and Wells reported on the Tabanidae injurious to

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[3]See Hine, 1903, p. 9; 1906, p. 25; Neave, 1912, p. 281; papers by Mosier and Snyder, et at., for statements on this disputed point.

[4]Now *Hybomitra captonis* (Marten), in Philip, 1947.

domestic stock in Antelope Valley, which extends from Nevada into California. *Tabanus phaenops* Osten Sacken[5] was found to be abundant and the males were numerous in the grass of swampy areas. The authors saw several crawl down grass culms to drink. In August, matings were observed in a rather dry pasture where the grass was knee-high. About 8:30 a.m. on a warm bright morning two were seen mating approximately eight feet above the ground. They flew rapidly and soon came to rest on a grass stem where they were captured. Between 8:00 and 9:00 a.m. on another day four flies were seen in air all clinging together. In about ten seconds they separated and flew away. Another mating pair came to rest on a grass culm and separated in about a minute and a half. Their observations did not reveal whether mating began in flight or at rest.

Bequaert (manuscript) has sometimes observed males of such North American species as *Hybomitra lasiophthalma* (Macquart) and of *H. epistates* (Osten Sacken) hovering in Syrphid fashion in woodland openings.

On June 9th and 10th in successive years and in different localities MacCreary (1940) observed mating pairs of *Chrysops fuliginosa* Wiedemann between 9:00 and 10:00 a.m. on cat-tails and other emergent vegetation. When disturbed they flew erratically a few yards to another resting place without separating.

Philip (1942) speaks lucidly of the matings of *Hybomitra metabola* (MacDonnough) which he observed on the bright warm forenoons of May 1 to 3 in and near his Hamilton, Montana, yard. He saw two meet in air, three feet from the ground, and hover momentarily while coupling. Then the female flew awkwardly to a nearby bush while the male hung inertly beneath. They so remained until taken. Later other males were seen hovering, usually over the lawn and near foundation shrubs. Fourteen specimens were captured. Three other pairs were also taken on the bushes; the males were always suspended limply. Hovering was discontinued just before noon each day and was not observed after May third although the weather remained unchanged.

The observations of Haseman (1943) are especially interesting when we recall those of Hine. Haseman saw *Tabanus sulcifrons* Macquart hovering at tree-top level, or about 30 feet. The swarming took place for 20 to 25 minutes after daybreak from July 27th to September 2nd around his Missouri home. At this time of day the light intensity ranged from 3 to 5 foot candles. Only males were hovering. Two were netted from a roof. While the males swarmed, females flew about the lawn and low shrubs. As the days grew shorter the flights started later. More specifically, on July 27th swarming started at 5:30 a.m. and on September 1st it did not begin until just after 6:00 a.m. No flights occurred when the temperature was below 60° F. The hovering was confined to restricted areas.

As the last species decreased in numbers, *Tabanus giganteus* DeGeer became more abundant. On September 9th several males of the latter were hovering 3 to 5 feet above the lawn and drive at dusk. These flights continued for about a week and the last males were seen September 15th. On September 9th three males with fully developed testes

[5]*Hybomitra sonomensis* (Osten Sacken) subsp. *phaenops* Osten Sacken (Philip, 1947).

were taken. Females were also captured but no mating was observed. Their flights started about 7:00 p.m. with 30 foot candles of light and lasted for 30 minutes. By this time the light intensity had dropped to an average of three foot candles. They often hovered a few feet from the observer.

Craig (1944) simply refers to the observations of Mosier and Snyder and of Haseman. He expresses the opinion that light intensities alone are probably responsible for the hovering of Tabanidae as well as the morning and evening singing of the Wood Pewee. This review clearly refutes his assumption since the recorded statements of various observers make it obvious that factors other than light are certainly involved. It may be pointed out that, contrary to his belief, hovering has been definitely associated with mating by Surcouf (1921b), Philip (1942), Bailey (1947 and below), and that others have considered a relationship probable. Furthermore, temperature is probably even more decisive than light intensity with the insects. However, a detailed investigation of all the factors involved is greatly to be desired.

This completes the chronological summary of the findings known to me with the exception of my earlier (1947) notes which need no amplification here in the light of the more recent study reported below.

FIELD NOTES

The investigation of the biology of *Tabanus nigrovittatus* Macquart was continued throughout the 1947 season on the saltmarshes of Essex County. Special attention was given to the mating habits of this species and a few more details gleaned from these observations follow.

Although no such mass swarming as we saw at Conomo Point in 1946 was seen this summer, on several occasions small numbers of flies were found hovering. It is probable that they engage in this activity whenever the weather is suitable. Usually it occurs before 9:30 a.m. daylight saving time on fairly bright, mild and calm mid-summer days. Only once, namely August 1st, were flies seen hovering at a later hour. This exceptional performance may be attributed to the fact that thunder showers the evening before were followed by a sharp drop in temperature. The thermometer stood at 54° F. at 8:00 a.m. that day and the greenheads hovered until about 11:00 o'clock.

Five mornings proved particularly favorable and on each of them time was spent studying this activity. Hovering flies were watched and efforts made to capture them while engaged in this kind of flight in order to determine their sex. On the following dates the specified numbers, a total of 29 males, were netted individually between 8:30 and 9:30 a.m., except on August 1st when the flies hovered until 11:00 and captures were made from 9:30 to 10:30 a.m.

Date	Place	Capture	Remarks
July 16..........	Crane Marsh, Ipswich	5 males	
July 24..........	Pine Island, Newbury	2 males	Mating also observed.
July 28..........	Pine Island, Newbury	12 males	
July 30..........	Pine Island, Newbury	5 males	Mating also observed.
August 1........	Pine Island, Newbury	5 males	

The flies were not abundant on any of these mornings and were very difficult to approach while hovering. The morning of July 16th was cool. Blustery breezes and intermittent cloudiness interrupted their activity. When the sun shone and the wind was not too brisk the flies would hover, but as soon as clouds cast their shadows on the marsh the greenheads dropped into the grass. Had the weather been more favorable, swarms of horseflies might have been expected since mid-July is the time when this species is normally at its annual population peak. The data given are scant but, when taken with the statements of the above authors, certainly indicate that hovering is primarily a male activity. The few females in such swarms (Cameron, 1934; Haseman, 1943) were perhaps attracted by the humming flight of the males and were not actually hovering with them. Further amplification is, of course, desirable, although it will be difficult to obtain. However, the difficulty of capturing hovering males of *Tabanus nigrovittatus* may be partly explained, if this is really the situation. One may stand quietly and watch them hover only a few feet away and about 6 to 12 inches above the short, lodged *Spartina patens* (Ait.) Muhlenberg which forms a dense cover at the upper limits of tidal overflow on the saltmarsh. As Surcouf noted for *Tabanus algirus* Macquart, several of this species may also hover in a small area, each maintaining its relative position until disturbed. If interrupted, they swiftly dash first one way and then another, but after such sudden excursions usually return to their original places and head into the wind. If another fly passes near one that is hovering, the latter darts towards it immediately. This frequently sets off a kind of "chain reaction" since the first fly and its pursuer often approach others hovering nearby and these in turn swiftly join the swirling pursuit. The chase is so rapid that the eye soon loses sight of the contestants. However, some appear to drop out of the race and resume their hovering positions. Presumably such excited activity results from the attempt of the hovering male to seize a female that flies close by and attracts his notice. On the other hand, I have once or twice seen a fly at rest on the grass directly beneath one of the hoverers and the latter remained utterly indifferent to the one below. But once the collector attempts to move within net-reach of hovering flies, those resting in the grass invariably rise and dart off ahead of him to disrupt the entire flight pattern in the manner suggested above. Then he must pause until the buzzing flies quiet down and assume their positions again. It is easiest to make a catch by approaching from behind. Since the flies orient themselves towards the direction from which the wind is blowing, one should move upwind swinging at fly after fly until successful. The hoverers are extremely alert and catches are infrequent. If the morning is somewhat cool, or the breeze too brisk, they often drop into the shelter of the grass. When they alight they are almost always facing upwards but they immediately turn around in a leisurely manner and often crawl well down towards the base of the culm. They hover only for brief intervals under these conditions. Since their reactions are slower on such days, they are a little more readily captured.

From my own observations, as well as from those of Surcouf, Cameron, Philip and Bouvier, it is evident that there is a definite

connection between the hovering of male Tabanidae and mating as previously noted. The exact nature of this relationship is not yet clear. Nevertheless, as Mosier and Snyder surmised, it may well be a kind of courtship phenomenon. In my original Conomo Point observations mass hovering and mating were going on simultaneously. As stressed above, both activities were again seen on each of two mornings at Pine Island. Since adult emergence is known to occur as late as August 8th (information based on collected pupa), and probably a few flies continue to emerge until the last of the month, it is not surprising that mating was observed on August 12th. Careful observations were made on four pairs found in copulation on the mornings of July 24th and 30th.

The margin of the saltmarsh near the northwestern edge of Pine Island is fairly dry except after extremely high tides and the fine fox grass forms a thick mat over which it is easy to slide. Therefore, I was able to lie down and crawl to within a foot or less of the mating *Tabanus nigrovittatus* Macquart without disturbing them. In this position my eyes were on the same level with the paired flies. In every case studied the males were quietly posed on a slender grass blade while the females were all rather restless. The male of the first pair under observation was clinging head-up to the tip of a *Spartina patens* leaf while the female was holding onto the same blade facing the turf. She moved actively and now and then vigorously pushed the tip of the male's abdomen with her hind tarsi as if attempting to terminate the union. They had been together for between five and ten minutes when a movement startled them and they disengaged. Although they flew but a short distance, only the female was taken.

On a nearby grass blade another pair was observed and similarly approached. In this case the male faced downward and the female necessarily faced in the opposite direction above him on the grass. She was moving as actively as possible under the circumstances. After watching them for a while, I attempted to take them but again netted only the female. It looked to me as if the male controlled the union and, consequently, had a slight advantage when danger threatened which enabled him to avoid capture. This is especially interesting, since on other occasions the males seem less alert. Several times when inclement weather kept them in the grass, sweeping has resulted in the capture of two, three or more males to every female taken. Some figures from the same part of the Pine Island marsh emphasize this fact. On July 21, 45 females and 130 males; on the 24th, 68 females and 97 males; on the 26th, 22 females and 45 males; and on the 28th only 4 females and 55 males were taken. On two of these mornings there was some hovering, as we have said, and mating was studied on the 24th. But the weather was sufficiently overcast or cool to curtail their activity greatly early in the morning. Under these conditions the males are more sedentary while the females will rise to annoy the intruder unless the weather is very disagreeable.

The positions of members of the third pair differed from the others in one respect. As in all but the second case, the male was clinging head uppermost to the grass blade tip. The female, however, was simply hanging freely beneath him and several times buzzed her wings as if attempting to break away. When I inadvertantly alarmed

them, the male flew a short distance, dragging the female along, and came to rest on the grass again. This happened twice. Flies of the fourth pair were in the same relative positions as those first described.

In concluding these remarks, a few other habits of this species may be noteworthy. Like many other Tabanidae, this one is often seen dipping to the water's surface as it flies between the banks of the saltmarsh ditches and canals when the tide is partly out. They may often be found in sunny places on the peaty ditch banks where they appear to be sucking the organic oozes. Two taken under these circumstances were both males. Unlike some species, *Tabanus nigrovittatus* was never observed about any of the flowers which flourished above the high tide line at the edge of the saltmarsh. However, occasional specimens carried anthers, probably of the marsh grasses, on their tarsi. We still have much to learn about the biology of this common species.

SUMMARY

This paper brings together the observations of a score of workers concerning mating and associated activities of Tabanidae. Such fragmentary notes record actual mating for only thirteen species distributed in the following six genera: *Chrysops*, 3; *Chrysozona*, 2; *Hybomitra*, 2; *Silvius*, 1; *Tabanus*, 4; and *Therioplectes*, 1. In only four instances are more than the barest details stated. Nine authors are responsible for the 13 cases cited. With the exception of *Chrysozona denshami* (Austen), which is said to mate at nightfall in the Belgian Congo and *Tabanus auropunctatus* Macquart of Algeria that mates in mid-afternoon, all species noted mate between 8:00 a. m. and noon. Fifteen writers have described, more or less fully, the hovering habits of 19 species in the following five genera: *Chrysozona*, 2; *Hybomitra*, 4; *Pangonia*, 1; *Tabanus*, 10; and *Therioplectes*, 2. Two of these, *Tabanus lineola* Fabricius and *T. giganteus* DeGeer, hover at dusk. The rest hover from dawn until sunrise or during the forenoon. Mating appears to be initiated in the air and is usually completed at rest on nearby vegetation. The evidence indicates that the swarming flight and hovering are of significance in the mating of certain Tabanidae. Original observations on the hovering and mating of *Tabanus nigrovittatus* Macquart are included. Twenty-nine males were captured individually while hovering. When added to the data of other observers, this indicates that hovering is primarily a male activity. This species dips to the surface of the water in the saltmarsh ditches. Two males were taken on the peaty bank of a ditch where they appeared to be sucking in the oozes. *T. nigrovittatus* is never seen near the flowers which bloom profusely at the border of the saltmarsh.

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LIST OF RECORDED COTTON INSECTS OF THE WORLD, by H. HARGRAVES. 50 pages. Commonwealth Institute of Entomology, London. 1948.

This work is intended to serve as a quick and easy reference to the names of all mites and insects recorded from cotton, the chief source of the compilation being volumes one to thirty-four inclusively of the Review of Applied Entomology. The insects are listed by order and, except for the minor orders, by family; the information given, covers the part or parts of the plant attached and the country or countries from which the species in question has been recorded from cotton. Forty concentrated pages are devoted to this material; all but six of these deal with Coleoptera, Lepidoptera, and Hemiptera (Heteroptera and Homoptera). There is a brief list of representative literature, an index to families and genera, and a geographical index.

The usefulness of this work in the United States is suggested by the item in the geographical index: "U. S. A., on every page with the exception of pp. 20 and 24." We note a Mexican record on page 24. A brief citation of authorities for the records would have added much to its value, but would also have increased the size of the paper.—M.T.J.

LARVAE OF SOME GENERA OF CALENDRINAE (= RHYNCHOPHORINAE) AND STROMBOSCERINAE
(Coleoptera: Curculionidae)

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The Calendrinae is that group of weevils to which belong the various billbugs, the granary and rice weevils, the banana root borer, and other less well known species. Larvae of the group have been the subjects of published, comprehensive studies by two authors. In 1924 Cotton treated the larvae of nine of the ten genera known to be established in America north of Mexico, presenting a key together with brief but adequate characterizations of the genera and carefully prepared illustrations. In 1934 and again in 1938 Gardner published keys and descriptions for the identified larvae of the species occurring in India. His fully illustrated papers also include keys to the larger groups of weevils, in so far as they were represented. There are several other papers which include descriptions or carefully prepared figures of larvae of the group, but they treat only one or a few species. These papers are listed in the bibliography. Since the appearance of Cotton's paper larvae of additional genera have become available for study, some from Central and South America, others from the islands of the Pacific Ocean. It is with the intention of making those larvae recognizable and indicating their position in a classification of the group based upon larval characters that this paper is prepared.

With the exception of the specimens of *Diathetes pandanae* Zimmerman and *D. lyriger* Marshall, which were kindly loaned to me by E. C. Zimmerman, Bernice P. Bishop Museum, Hawaii, the larvae described herein are in the collection of the United States National Museum. All the larvae studied are mature or nearly mature. The generic placement of all the larvae and nearly all the specific identifications can be considered as established beyond a reasonable doubt through rearing and identification of the adults by competent authorities.

Gardner, in 1934, treated the Calendrinae, Sipalinae based upon *Sipalus*, and Stromboscerinae based upon (*Xerodermus*) = *Orthosinus*, as separate although related subfamilies. In 1938 he considered the three groups as tribes of the Calendrinae. On the basis of the characters which will be pointed out below, I believe he is correct in considering *Sipalus* and its relatives as a group subordinate in importance to the Calendrinae. In my opinion, however, the Stromboscerinae[1] are sufficiently distinct to be treated as a separate subfamily, although

[1]The concepts of the Sipalini and of the Stromboscerinae, in the sense as used in the present paper, are based upon the material available for study.

I believe the relationship between the two groups, Calendrinae and Stromboscerinae, close enough to make it advisable to treat them in the same paper. It is believed that the combination of characters given below will serve to distinguish these two subfamilies from all others of which larvae are known.

Antenna consisting of one membranous article which bears a conical to subconical (rarely flattened and disc-shaped or subglobular) accessory sensory appendage[2] and several minute setae. Catapophyses in same plane as frons. Frontal suture usually distinguishable throughout its length, incomplete anteriorly. Epicranium with five dorsal, two lateral, two ventral, and four posterior setae. Frontal seta 5 subequal to or longer than frontal seta 4. Anterior margin of labrum rounded or slightly produced in the middle. Labrum with three pairs of setae and a pair of anterior sensilla which lie between the bases of labral rods (at extreme anterior margin of labrum in Stromboscerinae). Labral rods well developed, subparallel or convergent, often connected posteriorly. Some dorsal setae on mala commonly but not always branched. Typical abdominal segments with three or four dorsal folds. Well-developed spiracles present on abdominal segment VIII, dorsal in position and oriented so that the air tubes, when present, are directed strictly posteriad. Spiracles of typical abdominal segments vertical in orientation, i.e., the air tubes, when present, directed dorsad. Orifice of spiracles nearly always an elongate slit with subparallel margins. Spiracular area of typical abdominal segments with two setae. Pleurum subdivided into two or more lobes, one of which nearly always bears two setae, the subdivision incomplete in *Dryophthorus* and *Stenommatus*.

One of the more important diagnostic characters for larvae of these two subfamilies, as given above, is found in the orientation of the abdominal spiracles. An identical orientation, except on abdominal segment VIII, is found in known larvae of the Cholinae and in most of the known larvae of the Hylobiinae. The orifice of the spiracles on larvae of the Cholinae and most of the larvae of the Hylobiinae is an elongate slit, a condition found in nearly all the larvae of the Calendrinae and the Stromboscerinae. However, the air tubes of the spiracles on abdominal segment VIII are directed dorsad in larvae of the Cholinae and larvae of most of the genera of the Hylobiinae. Three genera placed or retained in the Hylobiinae by Marshall (1932)—namely, *Sternechus*, *Anchonus*, and *Heilipus*—contain larvae which differ from those of the other genera of the subfamily in that the spiracles on the abdominal segments are oriented so that the air tubes are directed nearly posteriad.

As has been indicated above, the Calendrinae and Stromboscerinae are considered to be closely related on the basis of characters of their larvae. On the other hand they are distinguishable at once by means of the characters expressed in the following couplet.

Frons with five pairs of setae (fig. 15); posterior pair of setae on postmentum separated by a distance less than one-half as great as that between those of middle pair (fig. 11); postdorsum of mesothorax and metathorax with three (*Sitophilus*) or four setae; (spiracles on middle abdominal segments nearly always distinct and readily discernible (fig. 17))...**Calendrinae** (p. 415)

[2]For an explanation of this and other terms see Anderson (1947).

Frons with four pairs of setae (fig. 14); posterior pair of setae on postmentum separated by a distance subequal to that between those of middle pair (fig. 10); postdorsum of mesothorax and metathorax with two setae; (spiracles on middle abdominal segments nonfunctional, scarcely discernible (fig. 9)), **Stromboscerinae** (p. 434)

Subfamily **Calendrinae**

Frons with five pairs of setae. Posterior pair of setae on postmentum separated by a distance which is one-third to one-half as great as that between setae of middle pair. Postdorsum of mesothorax with three or four setae. Pleurum of typical abdominal segments subdivided into three or more lobes.

Larva usually robust, small to large, subcircular in cross section, usually distinctly thicker through middle abdominal segments, with abdominal segments VIII and IX often flattened dorsally. Head free or partially retracted into prothorax, as long as or longer than broad, not emarginate posteriorly. Anterior ocellus present, usually moderately distinct; posterior ocellus absent. Clypeus with two setae and sensillum on each side near base. Epipharynx usually with six anteromedian setae and four median spines. Accessory sensory pores nearly always discernible on epipharynx. Epipharynx usually with distinct asperities. Mandible with one or two teeth. Two setae present on outer surface of mandible. Labial palpus with two articles. Ligula with four setae. Premental sclerite present, complete. Asperities often present on dorsal surface of mala.

Thoracic spiracle usually bicameral, rarely without air tubes. Spiracular area of mesothorax with one to four setae. Alar area with one or two setae. Pedal area with five to seven setae.

Typical abdominal segments with three or four dorsal folds. Prodorsal seta (rarely, *Rhinostomus*, more than one) present on typical abdominal segments. Pedal area distinguishable, with one seta. Eusternum with two setae. Anus usually ventral and anterior to posterior end of body, rarely terminal, never subdorsal. Asperities usually discernible, rarely hook shaped and large (*Cactophagus*).

With a few exceptions, most of which are in the Sipalini, larvae of the Calendrinae attack living herbaceous plants, largely grasses, although larvae of several genera attack living palms. Larvae of the Sipalini attack dead or dying plants, including dead trees.

KEY TO TRIBES OF CALENDRINAE

1. Abdominal segment VI abruptly smaller than segment V (fig. 1); branched setae on epipharynx (fig. 2) and on dorsal surface of mala tuftlike, **Sipalini** (p. 416)

   Abdominal segment VI only slightly or not smaller than segment V (fig. 17); setae on epipharynx (figs. 3 to 6) and on dorsal surface of mala simple or branched, not tuftlike.......... 2

2. Epipharynx with three or more than three anterolateral setae, some of the setae often branched (figs. 3 to 5); sensilla on epipharynx developed as pores (fig. 3) (except *Myocalandra*); postdorsum of mesothorax and metathorax with four setae; larva usually moderately large to large, not infesting seeds.......... 3

   Epipharynx with two, simple anterolateral setae (fig. 6); sensilla on epipharynx very small, peglike (fig. 6); postdorsum of mesothorax and metathorax with three setae; larva small, subglobular, infesting seeds and nuts.......... **Sitophilini** (p. 432)

3. Epipharynx with five or more than five simple anterolateral setae (fig. 5); mala with twenty to thirty dorsal setae; spiracles without air tubes; five postdorsal setae present on typical abdominal segments, **Rhynchophorini** (p. 418)
   Epipharynx with three anterolateral setae, the setae often branched (figs. 3, 4); mala with eight or rarely ten dorsal setae; spiracles bicameral (figs. 18, 19); three or four postdorsal setae present on typical abdominal segments....................................... **Calendrini** (p. 419)

Tribe Sipalini

Epipharynx with four to ten anterolateral setae, some of the anterolateral and the anteromedian setae tuftlike. One epipharyngeal sensory pore present on each side, each pore surrounded by a sclerotized ring. Mala with ten to thirteen dorsal setae, at least some of which are tuftlike. Asperities long and dense on dorsal surface of mala (evidently absent on *Sipalus*). Mesothorax and metathorax with four postdorsal setae. Five postdorsal setae present on typical abdominal segments. Sternellum present. Anus ventral, in front of posterior end of body. Abdominal segments VIII and IX with a cylindrical to subcylindrical process from each lateral margin, each process on segment VIII with two setae at the tip, each process on segment IX with three setae.

Larva moderately small to large, increasing in thickness rather gradually from prothorax to abdominal segment V then abruptly smaller and declivous through abdominal segments VI to IX. Head light orange, without distinguishable less heavily pigmented areas dorsally, partially retracted into prothorax. Endocarina absent. Paired basal sensilla present on labrum. Distinct asperities present on epipharynx. Ligula moderately produced, bearing one pair of tuftlike setae, the second pair branched or simple. Mala with three or four ventral setae.

Thoracic spiracle with or without air tubes. Spiracular area of mesothorax with three setae. Alar area with two short to very short setae. Pleurum of mesothorax and metathorax not subdivided, each area with one seta.

Setae on spiracular area of typical abdominal segments very short, subequal. Pleurum subdivided into four or five lobes. Asperities present and very fine or not discernible.

The larva of *Sipalus hypocrita* Boh., as described by Gardner (1934), appears to agree with the above characterization in most of the essential details, such as the abrupt reduction in size of the body behind abdominal segment V, the tuftlike setae on epipharynx and dorsal surface of mala, and the presence of fleshy processes from abdominal segments VIII and IX. It is evident that *Sipalus*, *Rhinostomus* and *Yuccaborus* form a natural, compact group. On the other hand, larvae of *Sipalus hypocrita* can be separated from larvae of the other two genera by the fact that there are two pairs of processes on posterior margin of abdominal segment IX in *Sipalus* whereas there is only one pair on larvae of *Rhinostomus* and *Yuccaborus*.

The relationships of *Anius* to the other Sipalini are not so evident, judging from the description of the larva of *Anius pauperatus* Pascoe by Gardner (1938). The figures of that larva (Gardner 1938, figs.

65–71) do not show an abrupt decrease in size of the body behind abdominal segment V, there are only three anterolateral setae on epipharynx and all epipharyngeal setae are simple, setae on dorsal surface of mala are fewer in number and branched but not tuftlike, and spiracles on abdominal segments II to VI are vestigial. The enumerated important characters indicate not only that *Anius* is not closely related to the other Sipalini, but rather that it approaches the Stromboscerinae as characterized below (see p. 434). Until its larva can be restudied in the light of the present interpretation of the importance of the various characters, it will be best to leave the relationships of *Anius* in question.

KEY TO GENERA OF SIPALINI

Sclerite on pronotum with red, irregular, transverse rugae near the posterolateral margins; epipharynx with ten tuftlike anterolateral setae (fig. 2), I. **Rhinostomus** (p. 417)

Sclerite on pronotum scarcely pigmented, without rugae near the posterolateral margins; epipharynx with four to six anterolateral setae, the more anterior setae tuftlike.......................................II. **Yuccaborus** (p. 418)

I. Genus **Rhinostomus** Rafinesque, 1815[3]

(Fig. 2)

Sclerite on pronotum orange, with red, irregular, transverse rugae near the posterolateral margins; smaller rugose areas present on spiracular areas of mesothorax and metathorax. Accessory sensory appendage of antenna rudimentary, consisting of a small flattened disc. Labral seta 2 short, tuftlike. Epipharynx with ten tuftlike, anterolateral setae. Thoracic spiracle elliptical, without air tubes. Abdominal spiracles without air tubes. Four prodorsal setae present on abdominal segments I to V.

Larva large. Lateral margins of head slightly convergent posteriorly, the posterior margin nearly transverse, shouldered on the ventral side. Ocellus moderately large, weakly convex. Labral rods nearly straight, subparallel, not connected posteriorly. Asperities on epipharynx laterally and in two lines between the labral rods, elongate, hairlike. Prementum covered with a pigmented sclerite, the anterolateral margins of which are heavily sclerotized. Mala with one of the ventral setae short, simple, the three posterior dorsal setae simple or with a few branches, the remaining setae tuftlike.

Principal areas on thoracic segments with orange sclerites. Spiracular area of mesothorax with two of the setae short to moderately long, the other seta very short. Mesothorax and metathorax with postdorsal setae short, subequal.

Spiracles on abdominal segments I to V narrow slits, subequal in size, those on segments VI and VII slightly larger, subdorsal, those on segment VIII elliptical. Typical abdominal segments with four dorsal folds. Pleurum subdivided into five lobes on abdominal segments II to V. Pleurum with three setae, two located on the second lobe from dorsum, the third seta on either the third or fourth lobe. Asperities not discernible.

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[3]Rafinesque proposed the name *Rhinostomus* to replace *Rhina* Latreille, 1802, which was preoccupied by *Rhina* Schaeffer, 1760, in fish.

Width of head: 5.5 mm. to 6 mm.

R. barbirostris (F.). Dominican Republic, in cocoanut palm. Honduras, February 1, 1917, in cocoanut palm, E. M. Anderson. Bahia, Brasil, G. Bondar.

II. Genus **Yuccaborus** Leconte, 1876

(Fig. 1)

Sclerite on pronotum scarcely pigmented, the remainder of body without pigmented areas. Accessory sensory appendage of antenna small, conical. All labral setae simple. Epipharynx with four to six anterolateral setae, the more anterior setae tuftlike. Thoracic spiracle bicameral, the air tubes without annulations, approximately one-third as long as elliptical peritreme. Spiracles on abdominal segments I to VII very small, with peritreme vague and with one or two poorly developed air tubes. One prodorsal seta present on abdominal segments.

Larva moderately small. Lateral margins of head smoothly rounded, oval posteriorly, not shouldered. Ocellus small, indistinct. Labral rods slightly arcuate, subparallel, connected posteriorly by a transverse bridge. Asperities sparse laterally on epipharynx, elongate and dense between the labral rods. Premental sclerite with slender anterior and posterior median extensions. Mala with three of the ventral setae simple, the remaining ventral and all dorsal setae with numerous branches.

Setae on spiracular area of mesothorax very short. Mesothorax and metathorax with postdorsal setae 1, 2 and 4 very short, 3 short.

Typical abdominal segments with three dorsal folds, fold I not distinguishable laterally. Pleurum subdivided into four lobes on abdominal segments II to V, the second lobe with two setae. Asperities very fine, generally distributed over whole body.

Width of head: 3 mm. to 3.2 mm.

Y. lentiginosus Csy. Ten miles northeast of Brownsville, Texas, June 4, 1904, in *Yucca*, larvae in galleries between bark and interior, the galleries similar to those of *Dendroctonus*, H. S. Barber.

Tribe **Rhynchophorini**

Body coarsely wrinkled, the wrinkles longitudinal, somewhat irregular. Frons with four subparallel, longitudinal grooves. Labrum with paired basal sensilla. Epipharynx with five or more than five anterolateral setae, the setae simple. Epipharyngeal sensory pores present. Mala distally truncate, with two ventral and twenty to thirty dorsal setae, the posterior dorsal setae placed at random, some of the dorsal setae bifurcate. Thoracic spiracle a simple, curved slit without air tubes. Postdorsum of mesothorax and metathorax with four setae. Pleurum of mesothorax and metathorax subdivided into three lobes, the middle lobe with a moderately long seta. Typical abdominal segments with five postdorsal setae. Posterior margin of abdominal segment IX with two pairs of broadly rounded projections. Asperities fine, dense, giving the appearance of a velvety coat, except on sclerotized areas.

Larva large, robust. Pronotum with paired reddish-brown sclerite.

Smaller reddish-brown sclerites on several body areas. Head dark brown, with subparallel, less heavily pigmented stripes dorsally. Endocarina absent. Ocellus absent or indistinct. Antenna small, completely surrounded by lateral portion of frons, directed laterad. Labral setae simple. Asperities present laterally on epipharynx and between the rods, particularly long and dense posteriorly between the rods. Ligula somewhat produced, apically truncate, the setae simple. Premental setae simple. Postmentum covered with light orange sclerite.

Spiracular area of mesothorax with three short to very short setae. Alar area with one short seta.

Abdominal spiracles without air tubes, those on segments I to VII small, near anterior margin of segment. Setae on spiracular area short to very short. Epipleurum subdivided into two poorly defined lobes, each lobe with one short seta. Sternellum and poststernellum present. Anus ventral, in front of posterior end of body.

The genera *Dynamis* and *Rhynchophorus* are doubtfully distinct on the basis of the observed characters of their larvae, and the differences indicated below are probably of no more than specific importance. For this reason no key to the two genera is presented.

III. Genus **Dynamis** Chevrolat, 1883

Prodorsum of mesothorax and metathorax with paired sclerite. Epipharynx with five or six anterolateral setae. Mala with twenty to twenty-two dorsal setae, the dorsal surface of mala without obvious asperities about the bases of anterior setae. Thoracic spiracle not obviously curved.

Width of head: 9 mm. to 10 mm.

D. borassi (F.). Ecuador, May 13, 1924, palms, F. Campos R., received through H. Morrison.

IV. Genus **Rhynchophorus** Herbst, 1795

(Fig. 5)

Prodorsum of mesothorax and metathorax without sclerites. Epipharynx with nine to thirteen anterolateral setae. Mala with twenty to thirty dorsal setae, obvious asperities usually present about the bases of anterior dorsal setae. Thoracic spiracle obviously curved.

Width of head: 7.5 mm. to 10.2 mm.

R. cruentatus (F.). Several lots of larvae, all from Florida, usually in cabbage palmetto.

R. palmarum (L.). Tumaco, Colombia, 1912, destroying cocoanut trees, G. H. Williams. "Juan Diaz," Venezuela, March, 1918, from cocoanut trunk, H. Pittier.

Tribe **Calendrini**

Epipharynx with three anterolateral setae, none of the epipharyngeal setae tuftlike. Epipharyngeal sensory pores present. Mala with eight or rarely ten dorsal setae, at least some of the dorsal setae usually branched but not tuftlike. Thoracic spiracle bicameral. Postdorsum of mesothorax and metathorax with four setae. Three or four post-

dorsal setae present on typical abdominal segments. Posterior margin of abdominal segment IX with four pairs of readily discernible setae.

Larva usually moderately large, slender to moderately robust. Posterior margin of abdominal segment IX with or without projections. Head usually distinctly pigmented and with dorsal, less heavily pigmented stripes. Endocarina usually present. Labral seta 2 often branched. Labrum with one basal sensillum or a pair of basal sensilla. Epipharynx with distinct asperities. Ligula with or without asperities. Postmentum usually partially covered with vague to distinct sclerite. Mala with three to five ventral setae. Dorsal surface of mala nearly always with elongate asperities among the setae.

Alar area of mesothorax and metathorax with one or two setae. Pleurum of mesothorax and metathorax not subdivided, each with one seta.

Typical abdominal segments with three or four dorsal folds. Sternellum present. Anus usually ventral, in front of posterior margin of segment IX, rarely subterminal. Asperities usually inconspicuous, rarely strong and hook shaped.

KEY TO GENERA OF CALENDRINI

1. Abdominal segments I to VII without discernible spiracles (*Polytus*) or the spiracles very small, without discernible air tubes (*Cosmopolites*); seta on epipleurum of metathorax distinctly shorter than on epipleurum of mesothorax 2
   Abdominal segments with spiracles present, occasionally small (*Myocalandra*) but then the air tubes well developed; seta on epipleurum of metathorax subequal in length to that on epipleurum of mesothorax (fig. 17) 3
2. Abdominal segments I to VII with spiracles, the spiracles small, without discernible air tubes; thoracic spiracle elongate, curved, the air tubes approximately one-fifth as long as peritreme (fig. 19); typical abdominal segments with three postdorsal setae . . . . . . V. **Cosmopolites** (p. 421)
   Abdominal segments I to VII without discernible spiracles; thoracic spiracle not curved, the air tubes distinctly longer than subtriangular peritreme (fig. 18); typical abdominal segments with four postdorsal setae . . . . . . VI. **Polytus** (p. 422)
3. Asperities present and distinct laterally on epipharynx (fig. 4), rather short in *Diathetes:* accessory sensory pores of epipharynx not situated between the labral rods, nearly always clearly outside the rods (fig. 4) 4
   Asperities absent lateral to rods on epipharynx (fig. 3); accessory sensory pores (peglike in *Myocalandra*) of epipharynx situated between the rods (fig. 3) 12
4. Dorsal surface of mala without asperities among the setae; endocarina absent; labrum with a pair of basal sensilla (as in fig. 7); all setae on epipharynx simple; dorsal setae on mala branched . . VII. **Diathetes** (p. 424)
   Dorsal surface of mala with asperities among the setae; with a different combination of the remaining characters 5
5. Posterior margin of abdominal segment IX with a pair of projections which are longer than broad (fig. 16) 6
   Posterior margin of abdominal segment IX usually without projections, occasionally with a pair of broad and truncate or short and bluntly conical projections 7
6. Each projection from posterior margin of abdominal segment IX bearing two elongate setae; setae on dorsal surface of mala simple, VIII. **Phacecorynes** (p. 424)
   Each projection from posterior margin of abdominal segment IX bearing three elongate setae (fig. 16); setae on dorsal surface of mala branched, IX. **Scyphophorus** (p. 425)

7. Posterior margin of abdominal segment IX with three pairs of elongate setae; length of air tubes of thoracic spiracle nearly twice as great as length of subtriangular peritreme............X. **Trochorhopalus** (p. 426)
   Posterior margin of abdominal segment IX with four pairs of elongate setae; length of air tubes of thoracic spiracle subequal to or distinctly shorter than length of peritreme.................................... 8
8. Body with stout, hook-shaped asperities arranged in rather regular rows, XI. **Cactophagus** (p. 426)
   Body without stout asperities, the asperities finer and not arranged in rows.. 9
9. All setae on mala simple; all epipharyngeal setae simple; length of air tubes of thoracic spiracle subequal to that of subtriangular peritreme, XII. **Rhodobaenus** (p. 427)
   All dorsal setae or at least more than half the dorsal setae (some species of *Calendra*) on mala branched; at least one pair of anteromedian setae on epipharynx branched; length of air tubes of thoracic spiracle usually distinctly shorter than that of peritreme.............................10
10. Labrum with a pair of basal sensilla (fig. 7); asperities on anterior half of prodorsum of abdominal segment I inconspicuous, not obviously stouter than those on the neighboring areas of the body; (eusternal setae on abdominal segment VIII usually short to very short, usually scarcely discernible).................................XIII. **Calendra** (p. 427)
    Labrum with one basal sensillum (fig. 8); asperities on anterior half of prodorsum of abdominal segment I conspicuous, occasionally pale, obviously stouter than those on the neighboring areas of the body; (eusternal setae on abdominal segment VIII usually moderately long, readily discernible)...11
11. Posterior margin of abdominal segment IX smoothly rounded or transverse; ligula with asperities (fig. 13)................XIV. **Metamasius** (p. 429)
    Posterior margin of abdominal segment IX with a distinct, smoothly excavated emargination; ligula without asperities (fig. 12), XV. **Rhabdoscelus** (p. 430)
12. Typical abdominal segments with three postdorsal setae; anterior dorsal setae on mala simple; (mala without discernible asperities dorsally; pronotum with transverse band of asperities along posterior border), XVI. **Myocalandra** (p. 430)
    Typical abdominal segments with four postdorsal setae; anterior dorsal setae on mala branched; (mala usually with long or short asperities dorsally; pronotum without transverse band of asperities, with or without median longitudinal band of asperities)...........................13
13. Anterolateral setae on epipharynx branched (fig. 3); one pair of setae on ligula branched (fig. 11); pronotum with median longitudinal band of pale asperities................................XVII. **Eucalandra** (p. 431)
    Anterolateral setae on epipharynx simple; setae on ligula simple; pronotum without median band of asperities...........XVIII. **Diocalandra** (p. 431)

V. Genus **Cosmopolites** Chevrolat, 1885

(Fig. 19)

Frontal seta 4 short to very short, seta 5 long. Labrum with one basal sensillum. Mala with five ventral and ten dorsal setae, the posterior seta on ventral surface and the nine posterior setae on dorsal surface branched. Air tubes of thoracic spiracle one-third to one-fifth as long as elliptical, often curved, peritreme. Alar area with one very short seta. Seta on epipleurum of metathorax usually distinctly shorter than that on epipleurum of mesothorax, the seta on pleurum of mesothorax and metathorax long. Spiracles on abdominal segments I to VII very small, with air tubes and peritreme scarcely discernible. Typical abdominal segments with three postdorsal setae. Posterior margin of abdominal segment IX without projections.

Larva moderately large, slightly thicker through abdominal segments

IV, V and VI. Head light orange, with narrow, short, nonpigmented stripes dorsally, free, longer than broad, the sides subparallel, rounded posteriorly. Endocarina present, one-third to one-half as long as frons. Labral seta 2 branched Labral rods united posteriorly. Epipharynx with the anterolateral and two pairs of anteromedian setae branched. Asperities on epipharynx moderately conspicuous laterally and between the labral rods, in evident tufts about the base of all anterior setae. Ligula not produced, without asperities. Mala with asperities on dorsal surface along the line of setae.

Spiracular area of mesothorax with one very short seta.

Typical abdominal segments with setae of spiracular area very short. Pleurum indistinctly subdivided into three lobes Asperities inconspicuous, sparsely distributed dorsally and ventrally on abdominal segments III to V.

Width of head· 2.7 mm. to 3 2. mm.

C. sordidus (Germ.). Numerous larvae from Florida, the West Indies, and several groups of islands of the Pacific Ocean, all from trunks or base of roots of banana. Almirante, Panama, December 1947, Manila hemp (*Musa textilis*), submitted through E. J. Hambleton.

VI. Genus **Polytus** Faust, 1895

(Fig. 18)

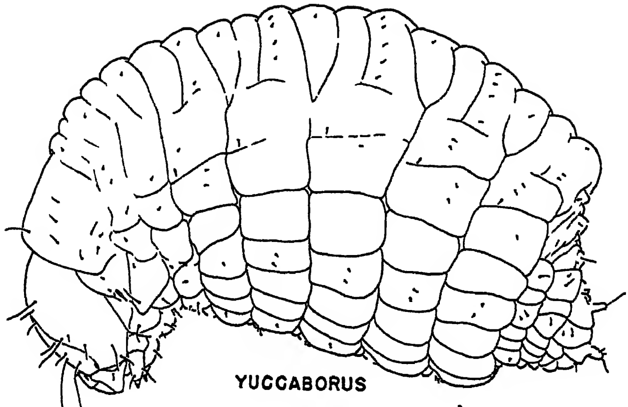
Frontal setae 4 and 5 long, subequal. Labrum with one basal sensillum. Mala with five ventral and eight dorsal setae, one ventral seta and all dorsal setae branched. Air tubes of thoracic spiracle distinctly longer than short, triangular peritreme. Alar area with one minute seta. Seta on epipleurum of metathorax and on pleurum of mesothorax and metathorax minute, the seta on epipleurum of mesothorax long. Spiracles on abdominal segments I to VII not discernible. Typical abdominal segments with four postdorsal setae. Posterior margin of abdominal segment IX without projections.

Larva comparatively slender, small, of nearly equal thickness throughout. Head light orange, with broad, vaguely defined less heavily pigmented stripes dorsally, free, slightly longer than broad, the lateral margins subparallel, broadly rounded posteriorly. Endocarina present, vague, approximately one-third as long as frons. Labral setae simple. Labral rods straight, convergent but not connected posteriorly. Epipharynx with two pairs of anteromedian setae branched near apex, the remaining setae simple. Asperities fine and sparse laterally on epipharynx, more dense and elongate between the labral rods. Inner surface of mandible, near base, with a prominent, triangular tubercle.

EXPLANATION OF PLATE I

(All figures drawn by author)

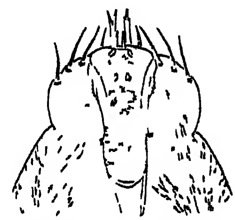
Fig. 1. *Yuccaborus lentiginosus* Csy., lateral view of larva, × 8. Fig. 2. *Rhinostomus barbirostris* (F.), epipharynx, × 20. Fig. 3. *Eucalandra setulosa* (Gyll.), epipharynx, × 75. Fig. 4. *Scyphophorus acupunctatus* Gyll., epipharynx, × 30. Fig. 5. *Rhynchophorus palmarum* (L.), epipharynx, × 40. Fig. 6. *Sitophilus rugicollis* (Csy.), epipharynx, × 165. Fig. 7. *Calendra ludoviciana* (Chttn.), labrum, × 30. Fig. 8. *Metamasius* sp., probably *anceps* (Gyll), labrum, × 30. *Dryophthorus distinguendus* Perkins, lateral view of larva, × 20.



YUCCABORUS 1

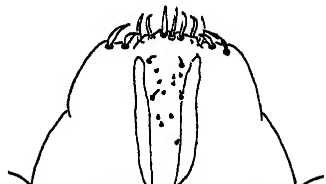
RHINOSTOMUS 2

EUCALANDRA 3

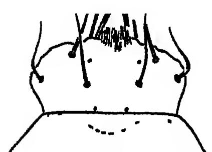


SCYPHOPHORUS 4

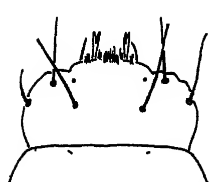
RHYNCHOPHORUS 5



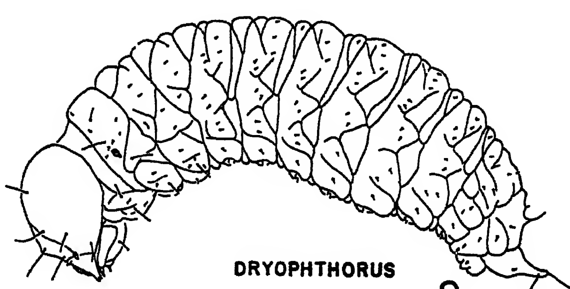
SITOPHILUS 6



CALENDRA 7



METAMASIUS 8



DRYOPHTHORUS 9

Ligula not produced, with asperities. Mala with elongate asperities on dorsal surface.

Spiracular area of mesothorax with one minute seta.

Typical abdominal segments with setae of spiracular area very short to minute. Pleurum indistinctly subdivided into three lobes. Asperities not discernible.

Width of head: 0.7 mm.

P. mellerborgi (Boh.). Manila, P. I., November 26, 1915, in banana plants infested by *Cosmopolites sordidus*, D. B. Mackey. Honolulu, T. H., March 27, 1935, ex banana corm, O. H. Swezey.

VII. Genus **Diathetes** Pascoe, 1874

Posterior margin of abdominal segment IX broadly emarginate, with a pair of short but distinct, bluntly conical projections, each projection bearing one seta at apex and another seta on ventral side at base. Endocarina absent, the apical angle of frons with a distinct pit. Labrum with a pair of basal sensilla. Asperities present but short and sparse laterally on epipharynx. Accessory sensory pores of epipharynx situated lateral to labral rods. Mala with three ventral and eight dorsal setae, the dorsal setae branched. Dorsal surface of mala without discernible asperities among the setae. Alar area with one short seta. Seta on epipleurum of metathorax elongate, subequal to that on epipleurum of mesothorax. Spiracles on middle abdominal segments only slightly smaller than on segments I and VI.

Larva moderately large, robust, thicker through abdominal segments III to V. Head reddish brown, with broad, vaguely defined, non-pigmented stripes dorsally, free, as broad as long. Labral setae simple. Labral rods convergent in anterior half, subparallel posteriorly. All epipharyngeal setae simple. Ligula broadly rounded, without asperities.

Air tubes of thoracic spiracle less than one-half as long as peritreme. Spiracular area of mesothorax with two very short setae.

Typical abdominal segments with three dorsal folds, fold I developed laterally, and four postdorsal setae. Setae on spiracular area very short. Pleurum subdivided into three lobes. Asperities scarcely discernible.

Width of head: 3 mm. to 3.8 mm.

D. pandanae Zimmerman. Vanua Mbalavu, Lau Province, Fiji, August 8, 1938, from *Pandanus* trunk, E. C. Zimmerman.

D. lyriger Mshll. Afiamalu, Upolu, Samoa, 2200 ft., June 27, 1940, *Freycinetia*, O. H. Swezey.

VIII. Genus **Phacecorynes** Schoenherr, 1845

Posterior margin of abdominal segment IX with a pair of elongate, cylindrical projections, each projection with two elongate setae near the tip. Labrum with one basal sensillum. Asperities present and distinct laterally on epipharynx. Accessory sensory pores of epipharynx apparently situated in the same vertical plane as the labral rods, not clearly between the rods. Mala slender, with four ventral and eight dorsal setae, all the setae simple. Alar area with two setae, one short, the other minute. Seta on epipleurum and pleurum of mesothorax and metathorax moderately long, subequal. Spiracles on typical abdominal

segments readily discernible, the length of the air tubes subequal to that of subtriangular peritreme. Typical abdominal segments with four postdorsal setae.

Larva moderately small, thicker through abdominal segments III to V. Head reddish orange, with narrow, nonpigmented stripes dorsally, free, as broad as long, broadly rounded posteriorly. Endocarina vague, approximately one-fifth as long as frons. Labral setae simple. Labral rods subparallel, connected posteriorly by a transverse bridge. All epipharyngeal setae simple. Ligula rounded, moderately produced, without asperities. Asperities on dorsal surface of mala short, sparse.

Air tubes of thoracic spiracle more than one-half as long as peritreme. Spiracular area of mesothorax with two setae, one very short, the other minute.

Typical abdominal segments with four dorsal folds, fold I complete dorsally although short. One seta on spiracular area minute, the other very short. Pleurum subdivided into three lobes. Asperities inconspicuous, generally distributed over whole body except on sclerotized areas.

Width of head: 1.5 mm.

P. zamiae (Gyll.). Port Elizabeth, Africa, May 21, 1936, in *Encephalartos coffra.*

IX. Genus **Scyphophorus** Schoenherr, 1838

(Figs. 4, 16)

Posterior margin of abdominal segment IX with a pair of elongate, cylindrical projections, each projection with three elongate setae near apex. Labrum with a pair of basal sensilla. Asperities present and distinct laterally on epipharynx. Accessory sensory pores of epipharynx situated just lateral to labral rods. Mala broad, with four ventral and eight dorsal setae, one of the ventral and all of the dorsal setae branched. Alar area with one short seta. Seta on epipleurum of metathorax long, subequal to that on epipleurum of mesothorax. Spiracles on typical abdominal segments readily discernible, the air tubes usually slightly longer than peritreme.

Larva moderately large, robust, strongly thickened through abdominal segments IV and V. Head dark brown, with convergent, nonpigmented stripes dorsally, free, slightly longer than broad, oval posteriorly. Endocarina absent. Labral setae simple. Labral rods slightly convergent posteriorly, connected by a transverse bridge. One pair of anteromedian setae on epipharynx branched, the remaining epipharyngeal setae simple. Ligula rounded, without asperities. Asperities present on dorsal surface of mala.

Air tubes of thoracic spiracle shorter than triangular peritreme. Spiracular area of mesothorax with two setae, one very short, the other minute.

Typical abdominal segments with three dorsal folds, fold I developed laterally. One seta on spiracular area very short, the other short. Pleurum subdivided into four lobes. Asperities inconspicuous.

Width of head: 3.5 mm. to 4.5 mm.

S.acupunctatus Gyll. Several lots of larvae have been studied, mostly from Arizona and a few localities in Mexico. Host plants included *Agave*, *Dasylirion* and mescal (*Lophophora*).

S. yuccae Horn. Los Angeles County, Calif., October 5, 1886, stems of *Yucca whipplei*, Koebele.

X. Genus **Trochorhopalus** Kirsch, 1877

Posterior margin of abdominal segment IX broadly emarginate or with posterolateral angles broadly produced. Labrum with one basal sensillum. Asperities present and distinct laterally on epipharynx. Accessory sensory pores of epipharynx apparently situated in the same vertical plane as the labral rods, not clearly between the rods. Mala with four ventral and eight dorsal setae, one ventral and all dorsal setae branched. Alar area with two setae, one short to very short, the other minute. Spiracles on abdominal segments II to V not more than one-half as long as on segments I and VI. Typical abdominal segments with four postdorsal setae.

Larva moderately small, moderately robust, thicker through abdominal segments III to V. Head dark reddish brown, with short, inconspicuous less heavily pigmented stripes dorsally, free, longer than broad, rounded posteriorly. Endocarina absent. Labral setae simple. Labral rods subparallel, connected posteriorly by a stout transverse bridge. One pair of anteromedian setae on epipharynx branched, the remaining setae simple. Ligula short, rounded, without asperities. Asperities present along the dorsal row of setae on mala.

Spiracular area of mesothorax with two setae, one very short, the other minute. Seta on epipleurum of metathorax moderately long, subequal to that on epipleurum of mesothorax.

Typical abdominal segments with three dorsal folds, fold I developed laterally. Setae on spiracular area very short, subequal. Pleurum subdivided into four lobes. Asperities inconspicuous, generally distributed dorsally on mesothorax, metathorax and abdominal segments I to V and ventrally on segments II to V.

Width of head: 1.75 mm.

T. strangulatus (Gyll.). Victorias, Occ. Negros, P. I., 1929, in sugar cane, W. D. Pierce.

XI. Genus **Cactophagus** Leconte, 1876

Asperities conspicuous, stout, hooked, arranged in transverse, nearly regular rows dorsally on metathorax and abdominal segments I to VII and present laterally or ventrally and laterally on the abdominal segments, the arrangement more confused laterally and ventrally. Labrum with one basal sensillum. All epipharyngeal setae simple. Asperities present and distinct laterally on epipharynx. Accessory sensory pores of epipharynx apparently absent, replaced by small clusters of asperities lateral to the rods. Mala with five ventral and seven dorsal setae, all setae simple. Alar area with two setae, one short the other minute. Spiracles on abdominal segments I to VII subequal. Posterior margin of abdominal segment IX without protuberances.

Larva large, robust, thicker through abdominal segments V and VI. Head brown, often with broad, vague, less heavily pigmented dorsal stripes, free, as broad as long, broadly oval posteriorly. Endocarina present, approximately one-third as long as frons. Labral setae simple.

Labral rods slightly convergent, connected posteriorly by a transverse bridge. Ligula projecting, rounded apically, without asperities. Asperities on dorsal surface of mala moderately long.

Spiracular area of mesothorax with three setae, one moderately long, one short, one very short. Seta on epipleurum of metathorax moderately long, subequal to that on epipleurum of mesothorax.

Typical abdominal segments with three dorsal folds, fold I developed laterally, and four postdorsal setae. Spiracular area with one seta very short to minute, the other moderately long. Pleurum subdivided into four lobes.

Width of head: 3 mm. to 5 mm.

C. spinolae subspecies *validus* (Lec.). Garden Grove, Calif., A. C. Davis. Tucson, Ariz., in *Cereus giganteus*, Hubbard and Schwarz, Hubbard No. 752.

Cactophagus sp. Mexico, March 25, 1946, in *Ferocactus*, V. O. Miller.

XII. Genus **Rhodobaenus** Leconte, 1876

(Fig. 15)

Labrum with one basal sensillum. All epipharyngeal setae simple. Asperities present and distinct laterally on epipharynx. Accessory sensory pores of epipharynx present lateral to labral rods. Mala with five ventral and usually eight dorsal setae, all setae simple. Length of air tubes of thoracic spiracle subequal to that of subtriangular peritreme. Alar area with two setae, one minute the other very minute. Spiracles on abdominal segments I to VII subequal. Asperities inconspicuous, generally distributed dorsally on abdominal segments I to V and ventrally on segments IV to VI. Posterior margin of abdominal segment IX with a pair of short, often inconspicuous, subconical projections, the projections not bearing setae.

Larva moderately large, moderately slender, slightly but distinctly thicker through abdominal segments IV to VI. Head orange, free, slightly longer than broad, broadly rounded posteriorly. Endocarina approximately one-half as long as frons. Labral setae simple. Labral rods convergent posteriorly, usually not connected by a transverse bridge. Ligula projecting slightly, without asperities. Asperities present on dorsal surface of mala near the row of setae.

Spiracular area of mesothorax with three very short to minute setae. Seta on epipleurum of metathorax moderately long, subequal to that on epipleurum of mesothorax.

Typical abdominal segments with four dorsal folds, fold I complete although short, and four postdorsal setae. Spiracular area with one seta very short, the other short. Pleurum subdivided into three lobes.

Width of head: 2.8 mm.

R. tredecimpunctata (Ill.). A common, widespread species the larvae of which are found in stems of numerous plants, largely composites.

XIII. Genus **Calendra** Clairville, 1798

(Figs. 7, 17)

Labrum with a pair of basal sensilla. One or two pairs of anteromedian setae on epipharynx branched, the remaining setae simple. Asperities present and distinct laterally on epipharynx. Accessory

sensory pores of epipharynx present, located lateral to labral rods. Mala with five ventral and eight dorsal setae, one ventral and at least six dorsal setae branched. Air tubes of thoracic spiracle one-half as long as or subequal in length to subtriangular peritreme. Alar area with two setae, one usually distinctly shorter than the other, the shorter seta occasionally scarcely discernible. Spiracles on abdominal segments I to VII subequal. Asperities usually more abundant on abdominal segments IV to VI, inconspicuous to moderately conspicuous, the asperities on anterior half of prodorsum of abdominal segment I not obviously stouter than those on the neighboring areas of the body. Posterior margin of abdominal segment IX without projections.

Larva small to moderately large, moderately robust, thicker through abdominal segments IV to VI. Head reddish brown to brown, with vaguely defined, nonpigmented stripes dorsally, free, approximately as broad as long, oval to broadly oval posteriorly. Endocarina usually less than one-half as long as frons. Labral seta 2 branched or simple. Labral rods connected posteriorly by a transverse bridge. Ligula slightly produced, nearly always with asperities laterally or apically. Asperities present on dorsal surface of mala.

Spiracular area of mesothorax with three setae, one usually distinctly longer than the remainder. Seta on epipleurum of metathorax long, subequal to that on epipleurum of mesothorax.

Typical abdominal segments with three dorsal folds, fold I developed laterally, and four postdorsal setae. Spiracular area with one seta distinctly longer than the other. Pleurum usually subdivided into four lobes. Eusternal setae on abdominal segment VIII usually short to very short and scarcely discernible.

Width of head: 1.7 mm. to 3 mm.

C. ludoviciana (Chttn.). Alvin, Tex., October 21, 1944, in stem of rice. Rosenberg, Tex., October 16, 1944, in stem of rice.

C. maidis (Chttn.). Columbia, S. C., August 30, 1881, in corn stalk, L. O. Howard. Meredith, Lee County, S. C., 1928, O. L. Cartwright.

C. cariosa (Oliv.). Grant, Fla., July 25, 1901, at roots of nut grass, R. T. Smith. Pierce, Tex., December 3, 1907, *Cyperus exaltatus*, J. D. Mitchell. Pompano, Fla., March 3, 1945, bases of old grass stems.

C. parvula (Gyll.). Washington, D. C., July 17, 1899, (*Agrostis stolonifera*) = *A. alba*.

Calendra sp., near *parvula* (Gyll.). Miles City, Mont., August 1938, injuring lawns, E. J. Woolfolk.

C. minima (Hart.). East Avon, N. Y., July 3, 1930, in wheat stems, C. C. Hill. Monmouth County, N. J., June 19, 1943, in wheat stem.

C. tarda (Fall). near Whittier, Calif., June 8, 1940, from lawn, H. D. Nelson.

C. zeae (Walsh). Morgantown, W. Va., September 11, 1899, on timothy, A. D. Hopkins.

C. callosa (Oliv.). Stillwater, Okla., July 31, 1895, chufa, A. N. Caudell. Silver City, N. M., August 8, 1899, corn, J. K. Metcalf. Arlington, Va., May 1, 1906. El Paso, Tex., several dates, in stalk or crown of corn.

C. pontederiae (Chttn.). Stoughton, Mass., August, 1924, in rootstalks, *Pontederia cordata*, D. H. Blake.

C. venata (Say). Beaumont, Tex., October 19, 1943, in rice stalk. Eagle Lake, Tex., November 16, 1943, in top roots of rice.

Calendra sp., probably *venata* (Say). Bay St. Louis, Miss., May 11, 1945, in roots of *Spartina*, G. Rau.

C. phoeniciensis (Chttn.). Alhambra, Calif., October 12, 1942, Bermuda grass, R. H. Smith. Los Angeles, Calif., June 17, 1944, in lawn, R. H. Smith.

XIV. Genus **Metamasius** Horn, 1873

(Figs. 8, 13)

Labrum with one basal sensillum. One, two or three pairs of the anteromedian setae on epipharynx branched. Asperities present and distinct laterally on epipharynx. Accessory sensory pores of epipharynx present, located lateral to labral rods. Ligula projecting, with asperities laterally and apically. Mala with four ventral and eight dorsal setae, one or more than one ventral and all dorsal setae branched. Air tubes of thoracic spiracle approximately one-half as long as elliptical peritreme. Alar area with two setae, one short to moderately long, the other minute. Spiracles on abdominal segments I to VII subequal. Asperities usually moderately distinct, those on anterior half of prodorsum of abdominal segment I obviously stouter than those on the neighboring areas of the body. Posterior margin of abdominal segment IX transverse to smoothly rounded.

Larva often large, robust, thicker through abdominal segments V and VI. Head orange or brown, usually with paler stripes dorsally, free, as broad as long, broadly oval posteriorly. Endocarina one-third to one-fourth as long as frons. Labral seta 2 occasionally branched. Labral rods usually connected posteriorly by a transverse bridge. Asperities abundant on dorsal surface of mala.

Spiracular area of mesothorax with three setae, one moderately long, the other two very short. Seta on epipleurum of metathorax long, subequal to that on epipleurum of mesothorax.

Typical abdominal segments with three dorsal folds, fold I developed laterally, and four postdorsal setae. Spiracular area with one seta distinctly longer than the other. Pleurum subdivided into three lobes. Eusternal setae on abdominal segment VIII usually moderately long, readily discernible.

Width of head: 3.2 mm. to 4.5 mm.

M. ritchiei Mshll. Six miles back of Kingston, Jamaica, September 16, 1917, pineapple, A. H. Ritchie.

M. hebetatus (Gyll.). Hamburg Farm, Reventazón, Ebene Limon, Costa Rica, November 3, 1933, in leaf sheath of *Iriartea*, F. Nevermann. (rec'd through F. van Emden.)

Metamasius sp., probably *anceps* (Gyll.). Region of Santa Cruz, Bolivia, received January 7, 1941, ex sugar cane. (rec'd from Bolivian Legation.)

M. sericeus (Oliv.). Cuba, January 6, 1928, in banana stalk. Canal Zone, February 28, 1928, in sugar cane.

M. sericeus var. *carbonarius* (Chevr.). Plantation Oaxaqueña, Santa Lucrecia, Vera Cruz, Mexico, September, 1911, in fermenting cane, Urich.

M. hemipterus (L.). La Merced, Peru, June, 1927, sugarcane stalks, C. H. T. Townsend. Puerto Rico, 1917, in royal palm.

XV. Genus **Rhabdoscelus** Marshall, 1943

(Fig. 12)

Labrum with one basal sensillum. At least one pair of anteromedian setae on epipharynx branched. Asperities present and distinct laterally on epipharynx. Accessory sensory pores of epipharynx present, located lateral to labral rods. Ligula rounded, without asperities. Mala broad, with three ventral and eight dorsal setae, all dorsal setae branched. Air tubes of thoracic spiracle approximately one-half as long as oval peritreme. Alar area with two setae, one short to moderately long, the other minute. Spiracles on abdominal segments I to VII subequal. Asperities moderately distinct, those on anterior half of prodorsum of abdominal segment I stouter than those on neighboring areas of body. Posterior margin of abdominal segment IX with a distinct, smoothly excavated emargination.

Larva moderately large, moderately robust, thicker through abdominal segments IV to VI. Head reddish brown, scarcely lighter dorsally, free, slightly longer than broad, broadly oval posteriorly. Endocarina approximately one-third as long as frons. Labral setae simple. Labral rods connected posteriorly by a transverse bridge. Asperities present on dorsal surface of mala.

Spiracular area of mesothorax with three setae, one long, the other two short to very short. Seta on epipleurum of metathorax long, subequal to that on epipleurum of mesothorax.

Typical abdominal segments with three dorsal folds, fold I developed laterally, and four postdorsal setae. Spiracular area with one seta long, the other minute. Pleurum subdivided into three lobes. Eusternal setae on abdominal segment VIII moderately long, readily discernible.

Width of head: 2.8 mm. to 3.2 mm.

R. obscurus (Boisd.). Widely distributed on the islands of the Pacific Ocean where it attacks banana, cocoanut palm and sugar cane.

XVI. Genus **Myocalandra** Faust, 1895

Head partially retracted into prothorax. Labrum with one basal sensillum. All setae on epipharynx simple. Asperities not discernible laterally on epipharynx. Accessory peglike sensilla of epipharynx present, clearly located between the rods. Setae on ligula simple. Mala with five ventral and seven dorsal setae, the one or two posterior dorsal setae branched, the remaining setae simple. Dorsal surface of mala without discernible asperities. Pronotum with transverse band of fine asperities along posterior border. Alar area with two very short, subequal setae. Typical abdominal segments with three postdorsal setae.

Larva small, moderately slender, slightly thicker through abdominal segments IV to VI. Head with anterior border light brownish yellow, distinctly longer than broad, bluntly oval posteriorly. Endocarina absent. Labral setae simple. Labral rods convergent and united posteriorly. Ligula not produced, with asperities apically.

Spiracular area of mesothorax with three short setae, one blunt

and bent, the other two attenuate. Seta on epipleurum of metathorax short, subequal to that on epipleurum of mesothorax.

Abdominal spiracles small but complete, the air tubes subequal in length to triangular peritreme. Typical abdominal segments with three dorsal folds, fold I developed laterally. Setae on spiracular area short to very short, one blunt, the other attenuate. Pleurum subdivided into four lobes. Asperities inconspicuous, short, more evident on abdominal segments III and IV.

Width of head: 0.6 mm. to 0.65 mm.

M. elongata (Roelofs). Japan, July 15, 1939, in bamboo stem of child's umbrella, F. C. Piper.

XVII. Genus **Eucalandra** Faust, 1899

(Figs. 3, 11)

Head slightly retracted into prothorax. Labrum with one basal sensillum. Anterolateral and anteromedian setae on epipharynx branched. Asperities developed in a pair of longitudinal, narrow bands along the labral rods, not discernible laterally on epipharynx. Accessory sensory pores of epipharynx present, clearly located between the labral rods. Anterior pair of setae on ligula branched. Mala with five ventral and seven dorsal setae, the six anterior dorsal setae branched, the remaining setae simple. Dorsal surface of mala with elongate, slender asperities. Pronotum with median longitudinal band of fine asperities. Alar area with two short to very short setae. Typical abdominal segments with four postdorsal setae.

Larva moderately small and robust, of nearly equal thickness through thoracic and first four abdominal segments, abdominal segments V to IX sloping. Head orange to reddish orange, lighter dorsally in two longitudinal stripes, longer than broad, oval posteriorly. Internal epicranial ridge distinct. Endocarina absent. Labral seta 2 branched. Labral rods stout, convergent but usually not united posteriorly. Ligula rounded, with asperities.

Spiracular area of mesothorax with three setae, two short, the third very short, cylindrical. Seta on epipleurum of metathorax moderately long, subequal to that on epipleurum of mesothorax.

Typical abdominal segments with three dorsal folds, fold I scarcely distinguishable laterally. Setae on spiracular area short, one cylindrical, the other attenuate. Epipleurum on anterior abdominal segments extending dorsal to a line connecting the spiracles, the setae comparatively widely separated. Pleurum subdivided into four lobes. Asperities inconspicuous, moderately abundant, generally distributed over whole body.

Width of head: 1.2 mm. to 1.3 mm.

E. setulosa (Gyll.). Several lots of larvae have been studied, from Mexico and northern South America. The most common host is bamboo although some specimens from Mexico were collected from stems of *Merostachys racimiflora*.

XVIII. Genus **Diocalandra** Faust, 1895

Head slightly retracted into prothorax. Labrum with one basal sensillum. All setae on epipharynx simple. Asperities not discernible

laterally on epipharynx. Accessory sensory pores of epipharynx present, clearly located between the labral rods. Setae on ligula simple. Mala with five ventral and eight dorsal setae, one ventral and all dorsal setae branched. Dorsal surface of mala with asperities present, short and sparse. Pronotum without median longitudinal band of asperities. Alar area with two short, subequal setae. Typical abdominal segments with four postdorsal setae.

Larva moderately small, moderately slender, only slightly thicker through abdominal segments IV to VI. Head orange to reddish orange, vaguely lighter dorsally, slightly longer than broad, broadly oval posteriorly. Endocarina present or absent. Labral setae simple. Labral rods slightly convergent posteriorly, connected by a transverse bridge. Ligula rounded, with asperities.

Spiracular area of mesothorax with three setae, one cylindrical, blunt, the other two longer, subequal, attenuate. Seta on epipleurum of metathorax moderately long, subequal to that on epipleurum of mesothorax.

Typical abdominal segments with four dorsal folds. Spiracular area with one seta very short, cylindrical, the other short to moderately long, attenuate. Pleurum subdivided into four lobes. Asperities inconspicuous, generally distributed over whole body.

Width of head: 1.1 mm. to 1.2 mm.

D. taitensis (Guer.). Hawaii, in petiole and husk of *Cocos nucifera*, several lots.

Tribe **Sitophilini**

This tribe is represented in the collection by larvae of *Sitophilus* only.

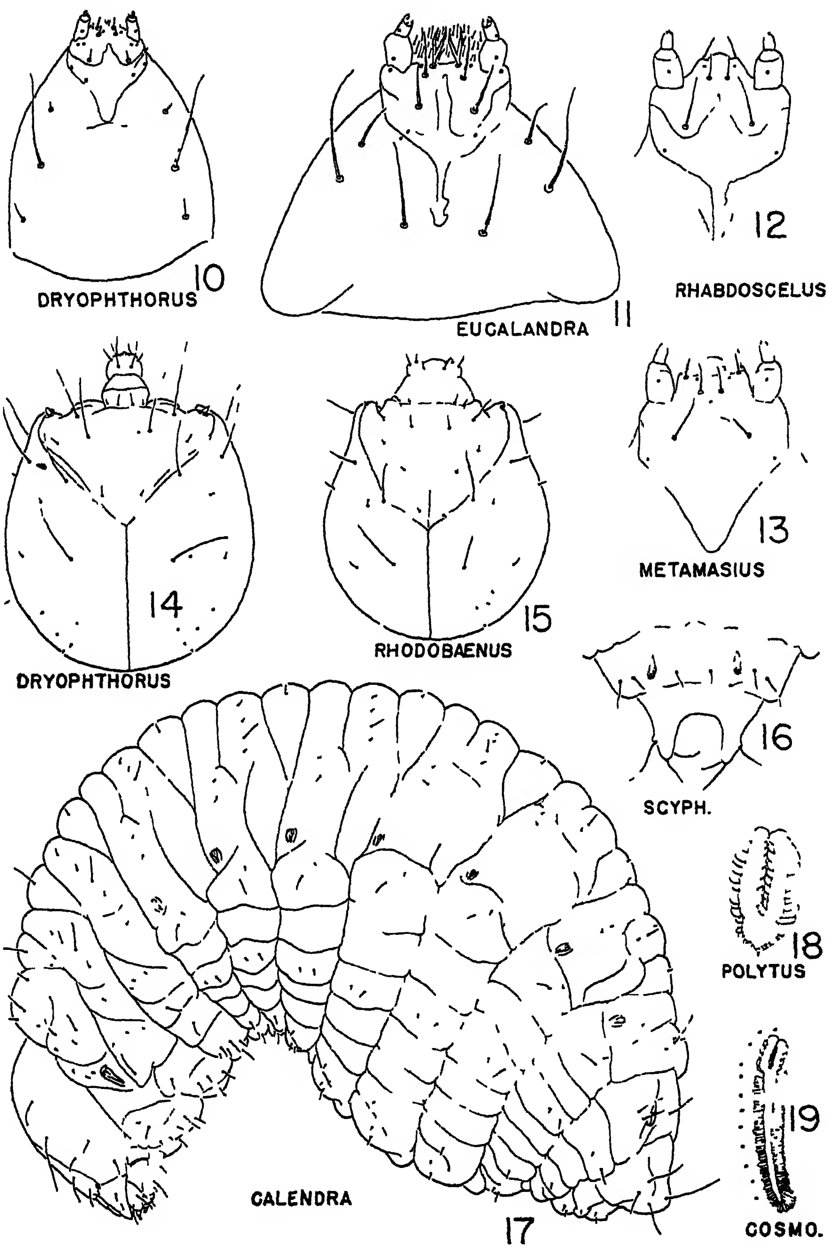
XIX. Genus **Sitophilus** Schoenherr, 1838

(Fig. 6)

Head partially retracted into prothorax, longer than broad, anterior border finely granulate. Labral setae short, subequal, simple. Labrum with one basal sensillum. Labral rods nearly straight, slightly convergent but not connected posteriorly. Epipharynx with two anterolateral setae. All setae on epipharynx simple. Sensory pores not discernible on epipharynx, replaced by minute, peglike sensilla. Mala with five ventral and four to six dorsal setae, all setae simple. Thoracic spiracle bicameral, the air tubes distinct. Typical abdominal segments with three postdorsal setae. Posterior margin of abdominal segment IX without projections, on each side with two setae, one moderately long, the other short to very short.

EXPLANATION OF PLATE II

Fig. 10. *Dryophthorus distinguendus* Perkins, labium, × 100. Fig. 11. *Eucalandra setulosa* (Gyll.), labium, × 75. Fig. 12. *Rhabdoscelus obscurus* (Boisd.), prementum, × 50. Fig. 13. *Metamasius ritchiei* Mshll., prementum, × 25. Fig. 14. *Dryophthorus distinguendus* Perkins, head, dorsal view, × 50. Fig. 15. *Rhodobaenus tredecimpunctata* (Ill.), head, dorsal view, × 15. Fig. 16. *Scyphophorus acupunctatus* Gyll., abdominal segments VIII and IX, dorsal view, × 30. Fig. 17. *Calendra maidis* (Chttn.), lateral view of larva, × 8. Fig. 18. *Polytus mellerborgi* (Boh.), left thoracic spiracle, × 165. Fig. 19. *Cosmopolites sordidus* (Germ.), left thoracic spiracle, × 75.


10
DRYOPHTHORUS
11
EUCALANDRA
12
RHABDOSCELUS
14
DRYOPHTHORUS
15
RHODOBAENUS
13
METAMASIUS
16
SCYPH.
17
CALENDRA
18
POLYTUS
19
COSMO.

Larva small, robust, subglobular. Body without pigmented areas. Head lightly pigmented, with posteriorly convergent, often vaguely defined dorsal, nonpigmented stripes. Endocarina present. Setae on frons moderately long, subequal. Ocellus moderately distinct. Accessory sensory appendage of antenna conical. Epipharynx without asperities. Ligula smoothly rounded, without asperities. Dorsal surface of mala without asperities.

Spiracular area of mesothorax with four setae. Postdorsum of mesothorax and metathorax with three very short setae. Alar area with one very short seta. Seta on pleurum and epipleurum of mesothorax and metathorax short.

Typical abdominal segments with three dorsal folds, fold I not distinguishable laterally. Typical abdominal segments with postdorsal setae very short, subequal. Setae on spiracular area very short, subequal, one seta blunt. Pleurum subdivided into three indistinct lobes, the middle lobe with or without one very short seta. Sternellum not distinguishable. Anus terminal. Asperities fine, usually blunt, generally distributed over body.

Width of head: 0.55 mm. to 0.85 mm.

S. granarius (L.), the granary weevil. Several lots of larvae, mostly from Greece and Turkey, attacking acorns and valonea nuts.

S. linearis (Hbst.). A common species frequently intercepted in tamarind seeds from Mexico, Central America and the West Indies.

S. oryza (L.), the rice weevil. Larvae examined from barley, chestnuts and acorns; also known to attack rice, wheat, corn, rye, etc.

S. rugicollis (Csy.). Malhan Range, Dehra Dun, United Provinces, India, ex seeds *Shorea robusta*, "R. O."

Subfamily **Stromboscerinae**

Frons with four pairs of setae. Epipharynx with three anterolateral and six anteromedian setae and four median spines, all simple. Posterior pair of setae on postmentum separated by a distance subequal to that between the setae of middle pair. Postdorsum of mesothorax and metathorax with two minute setae. Spiracles on abdominal segments II to VI scarcely discernible, each reduced to a minute sclerotic spot. Three minute setae on postdorsum of typical abdominal segments. Pleurum of typical abdominal segments incompletely subdivided into two triangular lobes. Abdominal segment VIII with one short fleshy process on each lateral margin. Abdominal segment IX terminal, its posterior margin with a pair of fleshy processes.[4] Anus ventral, subterminal.

Larva small, slender to moderately robust, slightly or not at all thickened through middle abdominal segments, with abdominal segments VIII and IX flattened to slightly concave dorsally. Head free. Internal epicranial ridge absent. Endocarina absent. Dorsal epicranial seta 2 minute, 1, 3 and 5 long. Lateral epicranial seta 1 minute, 2 long. Ocellus not distinguishable. (Gardner states that the ocellus in *Dryopthoroides* and (*Xerodermus*) = *Orthosinus* is present but small).

[4]If, as seems possible, *Anius* later proves to belong in the Stromboscerinae it will be necessary to alter this and a few other statements.

Clypeus with two setae and sensillum on each side, near base. Labrum with one basal sensillum. Epipharynx with one pair of minute conical sensilla in front of anterior pair of median spines, and with two clusters of sensilla, two or three in each cluster, located more posteriorly. Epipharynx with numerous, fine to distinct asperities between the labral rods. Mandible with two apical teeth. Two setae present on outer surface of mandible. Ligula with four setae. Premental sclerite complete, indistinctly pigmented, with short anterior and posterior median extensions. Mala with five ventral and seven dorsal setae.

Pronotum with ten setae, one moderately long to long, the remainder usually minute. Thoracic spiracle bicameral, the air tubes well developed, annulated. Spiracular area of mesothorax with one minute, blunt seta. Alar area with one minute seta. Epipleurum of mesothorax with one long seta, epipleurum of metathorax and pleurum of mesothorax and metathorax with one minute seta. Pedal area with four setae, one long, the others minute. Sternum with one pair of minute setae.

Typical abdominal segments with three dorsal folds. Prodorsal seta present on typical abdominal segments. Pedal area with one minute seta. Eusternum with two minute setae. Sternellum present. Individual asperities, when discernible, complex, with several minute points.

The Stromboscerinae, in the sense used here, includes *Dryophthorus*, *Stenommatus*, *Dryophthoroides* and *Orthosinus*, although larvae of only *Dryophthorus* and *Stenommatus* are available for study. Heretofore *Dryophthorus* and *Stenommatus* have been included in the Cossoninae on the basis of characters of the adults. A study of the characters of the larvae, however, shows that these two genera should not be placed in the Cossoninae. From the subfamily characters recorded above, larvae of typical Cossoninae differ as follows; epipharynx without asperities, or these indistinct; none of the setae on mala branched; spiracles well developed on middle abdominal segments; orifice of spiracles oval to subcircular; posterior end of body without fleshy processes; anus terminal, often subdorsal.

It should be pointed out that larvae of *Dryophthorus* and *Stenommatus* differ from those of *Dryophthoroides* and *Orthosinus* in two important characteristics. Gardner states that in *Dryophthoroides* and *Orthosinus* labial palpus has two articles and pleurum of each typical abdominal segment is subdivided into three lobes. In larvae of *Dryophthorus* and *Stenommatus* labial palpus has clearly only one article and pleurum on each typical abdominal segment is obscurely subdivided into two subtriangular lobes. In other characteristics, however, the four genera are remarkably similar. Perhaps the most significant characters which they hold in common are the reduction in size of spiracles on at least the middle abdominal segments, and the presence of fleshy processes at posterior end of body. It is unfortunate that Gardner did not remark upon the number of setae on frons. This number is often constant for all members of a tribe or subfamily among the Curculionidae.

One further fact should be noted. Larvae of *Dryophthorus* approach some of the Cossoninae in one peculiarity. The granular area on the

inner surface of the mandible resembles the condition found in *Caulophilus*, *Cossonus* and others. The similarities among the four genera here placed in the Stromboscerinae appear to be of more significance than those between *Dryophthorus* and *Stenommatus* and typical Cossoninae. For these reasons I believe that *Dryophthorus* and its relatives should be considered as forming a distinct group, separate from the Cossoninae and rather approaching the Calendrinae.

I have used the subfamily name Stromboscerinae for this group with some hesitation and mostly because it is an available name for the group which includes *Dryophthoroides* and *Orthosinus*. As far as can be ascertained the biology of *Stromboscerus* is not recorded and the characters of its larvae are unknown, and it is quite possible that the larvae will not have characters which indicate a close relationship with the larvae which are considered here.

KEY TO GENERA OF STROMBOSCERINAE

Frontal setae 4 and 5 long, subequal (fig. 14); inner surface of mandible with a granular area; abdomen with one pair of functional spiracles, on segment VIII..I. **Dryophthorus** (p. 436)

Frontal seta 4 minute, 5 long; inner surface of mandible without granular area; abdomen with two pairs of functional spiracles, on segments I and VIII, II. **Stenommatus** (p. 437)

I. Genus **Dryophthorus** Germar, 1824

(Figs. 9, 14)

Frons, near middle, with a pair of short, blunt, sclerotized tubercles (except *D. americanus*) and, near anterior margin behind catapophysis, with a low, narrow, transverse ridge (less distinct in *D. americanus*). Frontal setae 4 and 5 long, subequal. Inner surface of mandible with a comparatively large, subapical, slightly concave granular area, the granules in regular rows. Dorsal condyle of mandible projecting, with a distinct rim. Labial palpus with one article. Abdomen with one pair of functional spiracles, on segment VIII.

Head orange to dark orange, vaguely lighter dorsally or with paired, subparallel, nonpigmented stripes dorsally. Accessory sensory appendage of antenna subconical to egg-shaped. Clypeus narrow, rigid, seta 1 short, usually longer than 2. Median sensillum of labrum basal. Posterior clusters of sensilla on epipharynx located behind the posterior pair of median spines. Each branched seta on dorsal surface of mala with three to six branches.

Peritreme of thoracic spiracle subtriangular. Orifice of spiracle an elongate slit with smooth margins.

Abdominal segment VIII with a short, fleshy process on each lateral margin. Abdominal segment IX projecting posteriorly in two, well separated fingerlike processes.

Width of head: 0.5 mm. to 1.2 mm.

D. insignis Sharp. Kahaua, Oahu, T.H., January 19, 1930, from *Pipturus*, O. H. Swezey.

D. declivis Sharp. Kaimuahoua, Oahu, T. H., February 1928, from rotten wood, O. H. Swezey.

D. distinguendus Perkins. Honolulu, T. H., December 27, 1928, from telephone pole, O. H. Swezey.

D. modestus Sharp. Pupukea, Oahu, T. H., 1200 ft., October 30,

1927, from rotten log *Acacia koa*, O. H. Swezey. Kaimuahoua, Oahu, T. H., February 25, 1928, from rotten Bobea wood, O. H. Swezey.

D. americanus Bedel. near Plummers Island, Md., July 25, 1913, in rotting pine with *Micromalthus*, Schwarz and Barber. New York, N. Y., November 1937, in decaying wood from a cable manhole. Vienna, Va., March 19, 1942, from old rotten chestnut, J. C. Bridwell.

II. Genus **Stenommatus** Wollaston, 1873

Frons without tubercles and without ridge behind catapophysis. Frontal seta 4 minute, 5 long. Inner surface of mandible without granular area. Dorsal condyle of mandible not projecting and without a sharp rim. Labial palpus with one article. Abdomen with two pairs of functional spiracles, on segments I and VIII.

Head uniformly orange, slightly longer than broad, broadly oval posteriorly. Accessory sensory appendage of antenna egg-shaped to rounded apically. Clypeus broader than in *Dryophthorus*, not rigid, the clypeal setae minute. Median sensillum of labrum located approximately two-thirds the distance from base of labrum to apex. Posterior clusters of sensilla on epipharynx located between the anterior and posterior pairs of median spines. Each dorsal seta on mala with two branches.

Peritreme of thoracic spiracle broadly oval. Orifice of spiracle indistinct, apparently an irregular slit.

Abdominal segment VIII with one low process on each lateral margin. Abdominal segment IX projecting posteriorly in two short, broad, flattened, indistinctly separated, apically notched processes.

Width of head: 0.3 mm.

S. museae (Mshll.). Honolulu, T. H., March 27, 1935, from banana corm, O. H. Swezey.

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MOUND CHANGES AFTER TEN YEARS IN COLONIES OF FORMICA EXSECTOIDES FOREL

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In May 1936[1] a population survey of the mounds of *Formica exsectoides* was made in a ten acre plot near Beltsville, Maryland. The position of each mound was plotted on a chart and the height measured. Ten years later this chart was used in making a resurvey. The area then showed few changes in plant development other than normal growth. A few Virginia pines had been cut along one side adjoining an area that had been cleared and cultivated sporadically before 1936.

In 1946 there were 86 mounds, an increase of 13. Of the 73 mounds present in 1936, 54 were found. Eight of these had been abandoned, 17 were lower than ten years before, five were the same heighth, and 24 were higher. Of those lower than before, three had been damaged by animals and five had moss growing over part of the cone, an indication of senility. Sixty-six per cent of the colonies had maintained themselves in the same mound for the ten years; only half of them had increased the mound height.

The heights of the mounds ranged from 3 to 27 inches, with 14 and 15 inches the most frequent. In 1936, 13 inches was the most frequent height. The 24 mounds that were higher at the second measuring had a range of increase from one to 14 inches. The average increase was 6.4 inches.

In 1946, 19 mounds were 20 inches or more in height, of which 17 were present ten years ago. Nineteen mounds ten inches or less in height were found, of which 15 were not present in 1936.

The 37 mounds located for the first time in 1946, ranged in height from 3 to 22 inches, with four mounds 11 inches and four 15 inches high. One of these known to have been built by a migrating colony, attained a height of 12 inches in one summer.

Conditions that encourage growth, both in numbers of mounds and in increased height, were studied with respect to distance from trees, height of trees, presence of undergrowth and relative amount of sunlight. New mounds were found scattered over the entire area, with three locations having slightly higher percentages of increase. Two of these locations were on the edge of the cleared area where the light intensity was greatest. The third was within the woods where the light was reduced because of numbers and height of trees.

Another location, noticeable because only five mounds were active where 13 had been in 1936, had trees, oaks mostly, that had grown considerably so that the sunlight had been reduced by several hours a day.

The various factors considered seem to have some bearing on the increase in the number of mounds but no clear correlation could be found between the increase and any of the factors studied. No studies were made of the nest population nor of the abundance of food.

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[1]Cory, Ernest N., and Elizabeth E. Haviland, 1938, Ann. Ent. Soc. Amer., 31: 50–57.

THE WINGS OF BRACONIDAE

(Hymenoptera)[1]

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Various systems of naming have been used for the veins and cells of hymenopterous wings. These fall into two groups; those evolved for use in taxonomy as convenient descriptive terms, and those used to indicate structural homologies.

Rohwer and Gahan (1916) attempted to bring together all the systems and to establish one set of terms for use in all Hymenoptera. This is still a very useful paper, especially when one is trying to interpret the keys and descriptions of past workers. These authors rejected the Comstock-Needham system because they felt that it was not stable enough at that time to warrant adoption by taxonomists in the Hymenoptera. They added, "We believe it is much better for taxonomic work to designate a given area by a given name and call it that regardless of its possible homologies or analogies. As a system of designating veins and cells for the morphologist the Comstock-Needham system possesses certain advantages, but as a terminology to be used in taxonomic work we do not believe it is desirable." And indeed there seems to have been some justification for this statement at that time. In discussing the above quotation Ferris, in his book on the principles of systematic entomology (1928) said, "Why this artificial division between systematics and morphology should have arisen is difficult to see....However...the division clearly exists, as is unmistakably indicated by the statement just quoted. It exists to the great detriment of our systematic work."

Prior to Rohwer and Gahan's paper, others had tried to standardize the terminology of hymenopterous wings. Shuckard (1836), Haliday (1838), André (1879), and Morley (1909) are examples. The latter author gives a good historical review of the subject.

As recently as 1927 the late D. S. Wilkinson, by means of tables and very clear diagrams, proposed a set of descriptive terms for use in the Braconidae. And many of his terms differed from those selected by Rohwer and Gahan. So it would seem that changes in terminology are not limited to the morphologists, but will continue to be proposed by taxonomists.

Advances in the so called Comstock-Needham system have been great since 1916, and I feel that this system now can be used throughout

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the order with little confusion. The advantages of this flexible system over inflexible descriptive terms are obvious. With it the taxonomist can appreciate homologies with groups of insects other than his own, and characters furnished by the wings are applied more easily to problems of phylogeny. Further, inasmuch as the Comstock-Needham system is taught almost exculsively in the schools, it is a distinct task for the student to learn and apply the older system.

In his admirable paper on the wing venation of the Hymenoptera, Ross (1936) has advanced a modification of the Comstock system that seems to put the application of that system in the Hymenoptera on stable ground. His interpretation of the hymenopterous wing is logical, easily understood, and holds up well for the entire order. It is followed in this paper. Ross (*op. cit.*), and Duncan (1939), have reviewed the pertinent morphological literature. Burks (1938) has shown how Ross' modification applies to the Chalcidoidea, Duncan (1939) has used it for the Vespinae, and Michener (1944) has applied it to the bees.

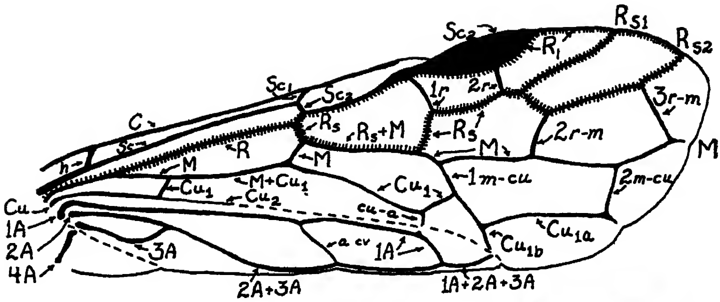
While the Comstock system has been applied to other families in the order, to the best of my knowledge it has never been used in a taxonomic paper on the Braconidae. It is the purpose of this paper to show how Ross' modification applies to the various types of braconid wings, and thus make it available to taxonomic workers in that family. I intend to use it in a forthcoming paper revising certain braconid genera.

In a few cases where complex serial veins occur it will probably be suggested by some, as it has been in the past, that this system is too cumbersome. For this reason shortened designations are proposed in this paper for optional use in descriptions (Table I), thus preserving the best features of the old and new systems. I am aware that this concession also will bring criticism, but feel that the advantages of the new system, even thus modified, outweigh any valid objections.

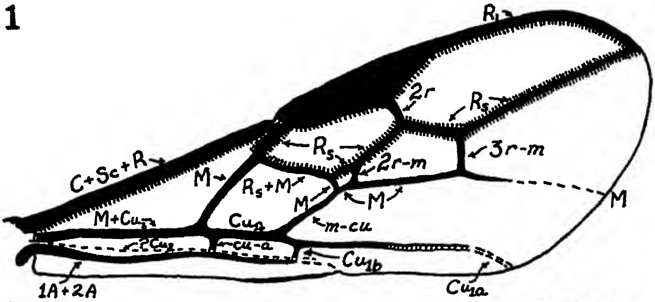
The venation of even the most primitive braconid front wing is much reduced when compared with that of the sawflies. Costa, subcosta and radius are pressed together along the anterior margin of the wing proximad of the large stigma. The stigma is composed largely of subcosta, with R_1 extending along the posterior edge. The branches of radius that remain are R_1, as mentioned above, and the first branch of the radial sector (R_s). Media is unbranched, and is joined with first cubitus for almost the proximal third of its length. First cubitus is branched into Cu_{1a} and Cu_{1b} at its distal end, although Cu_{1b} may be very faint or absent. Second cubitus, if actually present, is probably represented by a concave furrow. In most genera only one anal vein is present, and this probably represents fused 1A and 2A. In a few cases 2A branches off separately, and some genera exhibit a weak 3A. The cross-veins usually present in the braconid front wing are 2r, 2r–m, 3r–m, m–cu and cu–a. However, as will be pointed out below, it is possible that 2r–m is absent in some genera. *Helcon* possesses an anal cross-vein.

EXPLANATION OF PLATE I

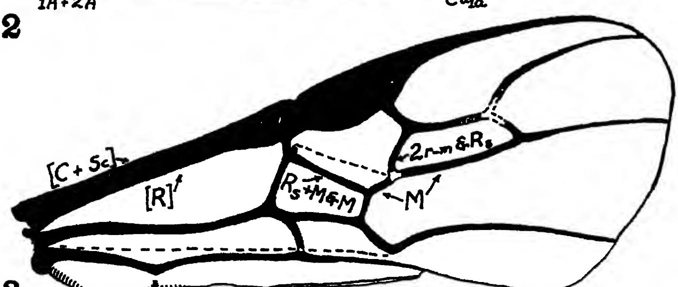
Front Wings. Fig. 1. Hypothetical hymenopterous wing (after Ross, 1936). Fig. 2. *Alysia ridibunda* Say (Alysiinae), freak. Fig. 3. *Cardiochiles* sp. (Cardiochilinae). Fig. 4. *Earinus* sp. (Braconinae), freak.


Sc2
R1
Rs1
Rs2
Sc1
Sc2
1r
2r
3r-m
C
Rs
Rs+M
Rs
2r-m
M
Sc
R
M
M
h
M
M+Cu1
Cu1
1m-cu
Cu1
Cu2
2m-cu
Cu
cu-a
1A
Cu1a
2A
a cv
1A
Cu1b
3A
4A
2A+3A
1A+2A+3A

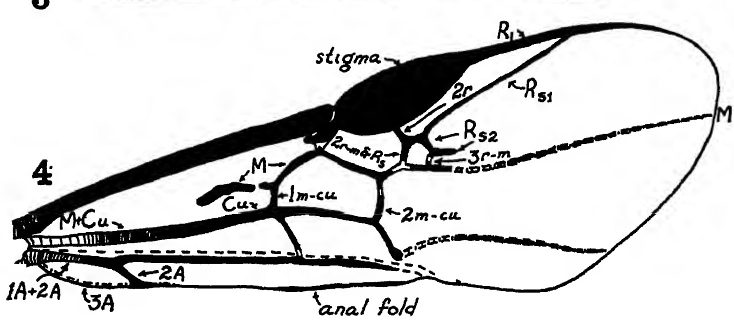
1


R1
2r
Rs
Rs
3r-m
C+Sc+R
M
2r-m
Rs+M
M
M
M
M+Cu1
Cu2
m-cu
Cu2
cu-a
Cu1b
1A+2A
Cu1a

2


2r-m & Rs
[C + Sc]
[R]
Rs+M & M
M

3


R1
stigma
2r
Rs1
M
Rs2
2r-m & Rs
3r-m
M
1m-cu
Cu
2m-cu
M+Cu
2A
1A+2A
3A
anal fold

4

Ross' hypothetical hymenopterous wing is shown in Fig. 1 with radius cross-hatched. The wing shown in Fig. 2 is easily homologized with the hypothetical type. It is a freak in that the small segment of R_s at the back of cell $1R_1$ is present (see Fig. 7 for cells), whereas it is normally gone from this species and from most other braconid wings (see Fig. 3). I was not entirely satisfied with the belief that a small segment of R_s had dropped out in the braconid wing, leaving R_s+M&M and $2r-m$&R_s, until the freak was discovered with this part of R_s still present. This apparent reversion to the primitive braconid type seems to prove the identity of veins R_s+M&M and $2r-m$&R_s and to lend weight to Ross' hypothetical wing, as the braconids are believed to be the link between the Symphyta and the rest of the Apocrita.

This discal area of the wing is usually the weakest part, and seems to be the place where the most recent modifications have taken place. The dashed lines in cell $1R_1$ of Figs. 3, 10, 11 and 23 represent furrows that apparently are not atrophied veins, but secondarily developed creases due to the pull of the hamuli of the hind wings (Fig. 33) on the anal fold (Fig. 4). Furrows of this type occur in many other braconid wings besides the four illustrated.

The aberration found in this specimen of *Alysia ridibunda* Say (Fig. 2) may or may not be the type noted by Schulz (1912) in *Alysia manducator* (Panzer), a common European species, and which he interpreted incorrectly, perhaps because he used the old system of venational nomenclature.

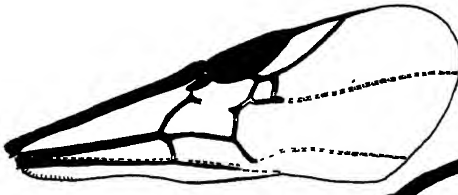
The *Earinus* wing shown in Fig. 4 is probably a freak. It shows a stub of R_{s2}, whereas this branch usually is represented in the braconids at most by a faint crease in the membrane as shown in another braconine, Fig. 6. Further, the stub that is labeled M in Fig. 4 may indicate that, in the subfamily Braconinae, media until fairly recently separated from cubitus nearer the base of the wing. Note the distinct angulation of the basal segment of M in Fig. 6. Of course this apparent stub of M in this wing of *Earinus* could be a new mutation in this one specimen.

It should be emphasized that in the two freaks illustrated (Figs. 2 and 4), the variation in venation occurs in both the left and right wings.

Whiting (1921, 1924, 1926, 1932, and 1934) has illustrated variations that occurred in the wings of inbred lines of *Microbracon hebetor* (Say). He demonstrated that the tendency to lose $3r-m$ is inherited in *Microbracon*, although influenced by environmental conditions. Besides this condition there occurred in his stocks very rarely (on the average of about once in 10,000 insects) freak types of venation, consisting of branching of veins or their reduction or increase in number. These freak wings occurred on one side only. Breeding experiments failed to establish a Mendelian basis for these rare, one-sided freaks. Muta-

EXPLANATION OF PLATE II

Front Wings. Fig. 5. *Bracon haematodes* (Brullé) (Braconinae). Fig. 6. *Crassomicrodus divisus* (Cresson) (Braconinae). Fig. 7. *Helcon dentipes* Brullé (Helconinae). Fig. 8. *Microplitis melianae* Viereck (Microgasterinae). Fig. 9. *Mirax ectoedemiae* Rohwer (Microgasterinae). Fig. 10. *Chelonus annulipes* Wesmael (Cheloninae). Fig. 11. *Aridelus fisheri* (Viereck) (Euphorinae). Fig. 12. *Ichneutes* sp. (Ichneutinae). Fig. 13. *Apanteles megathymi* Riley (Microgasterinae). Fig. 14. *Paxylomma* sp. (Paxylommatinae).



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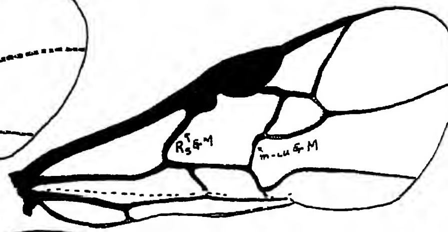

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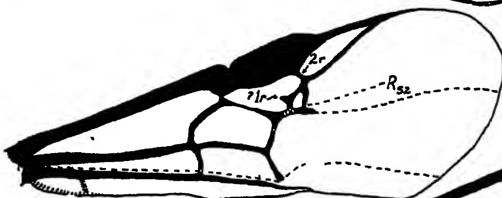

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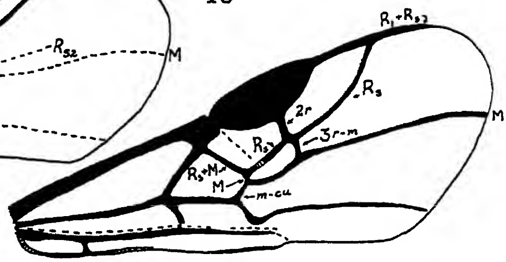

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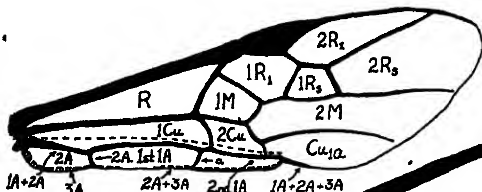

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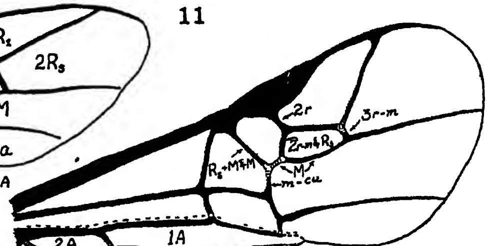

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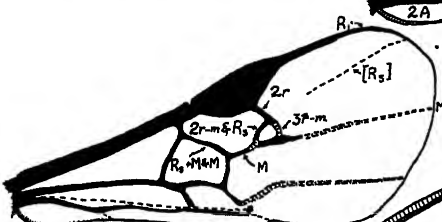

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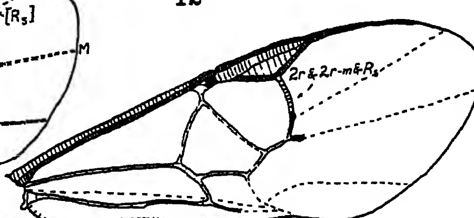

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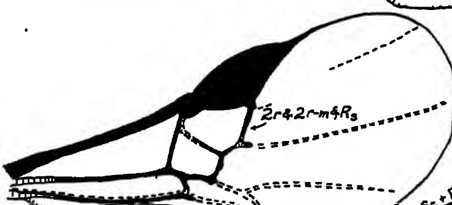

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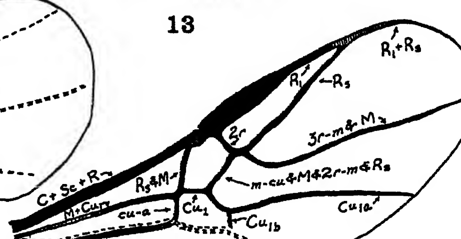

14

tions produced in his inbred lines that altered the shape, size, condition or position of the wings are not considered here, because the basic pattern of the venation was not affected. Three mutations that appeared in his stocks that affected the venation of both wings (Reduced, Shot, and Broad) and that were inheritable, produced an appearance that, if found in specimens taken in the field (which is unlikely), would be recognized for what they are. The same is probably true of the mutation Veinless (see Martin, 1947). The mutations just mentioned do not resemble the two freaks illustrated in Figs. 2 and 4. It seems to me that some of the "freaks" that are found in nature may be the result of recessive genes that are able to express themselves after having been masked for a time during the history of the species. If this is true, some of the freaks we find, such as are shown in Figs. 2 and 4, may be employed legitimately to trace the reduction of the venation from the primitive type.

In many wings the separate elements of C+Sc+R and the stigma may be seen due to differences in pigmentation. This is diagrammed in Figs. 3, 12, and 13.

While most braconids have cell $1R_1$ shaped as in Fig. 7, in some (Figs. 11, 21, and 23) it assumes a different shape probably because the proximal end of the 1st segment of R_s (see Table I below) has migrated back along R_s+M. Such changes in position of a vein are not unknown in other Hymenoptera. The alternative interpretation is that 2r−m has dropped out instead of the small segment of R_s (see Fig. 2). While either change may have taken place, the former seems more likely. However, as no evidence for either is at hand, and in order to simplify the use of this sytem, it will be assumed that 2r−m is missing in wings of this type.

Helcon (Fig. 7) preserves the greatest number of veins in the anal area of the wing. However, the anal veins are remarkably complete in various other forms (Figs. 3, 4, 5, 6, 8, 10, 11, and 12). These remnants of 3A are best seen in wings mounted dry and studied under reflected light. *Helcon* is the only braconid genus known to the writer where the anal cross-vein is preserved, and is thus the only one with two first anal cells. In most cases the cell nomenclature is simpler as is shown in Fig. 12.

What appears to be a remnant of 1r in Fig. 6 may actually be a stub of R_s with the free end directed toward the front of the wing (compare with Fig. 2).

Great reductions in some Microgasterinae (Figs. 9 and 13) and the Paxylommatinae (Fig. 14) have resulted in several rather complex serial veins. As long as the taxonomist makes clear to his reader what

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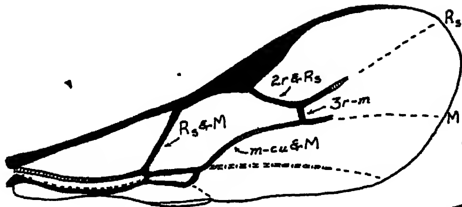
EXPLANATION OF PLATE III

Front Wings. Fig. 15. *Aphidius ribis* Haliday (Aphidiinae). Fig. 16. *Lysiphlebus testaceipes* (Cresson) (Aphidiinae). Fig. 17. *Diaeretus rapae* (Curtis) (Aphidiinae). Fig. 18. *Chorebidea* sp. (Dacnusinae). Fig. 19. *Oenonogastra microrhopalae* (Ashmead) (Alysiinae), stigma of male. Fig. 20. *Oenonogastra microrhopalae* (Ashmead), stigma of female. Fig. 21. *Aspilota* sp. (Alysiinae). Fig. 22. *Synaldis* sp. (Alysiinae). Fig. 23. *Heterospilus languriae* (Ashmead) (Hormiinae). Fig. 24. *Aphaereta* sp. (Alysiinae). Fig. 25. *Phaenocarpa* sp. (Alysiinae), male.



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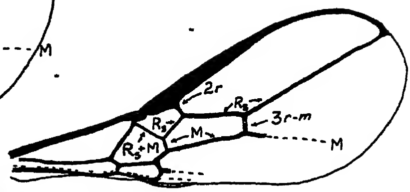

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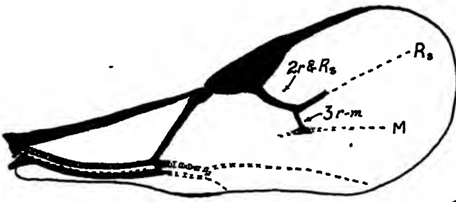

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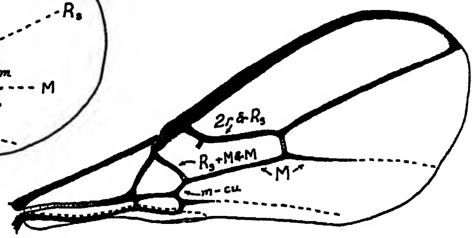

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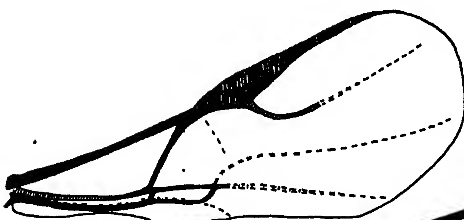

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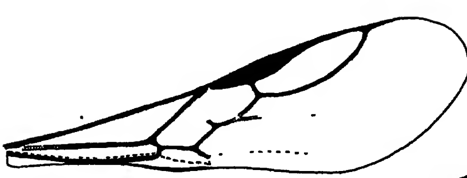
23



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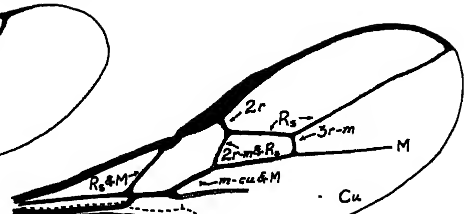

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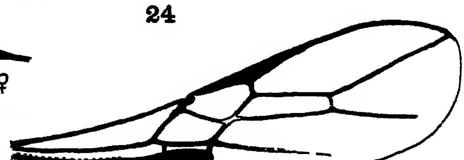


25

these veins really are, no harm will be done by using a shortened designation for them, similar to those proposed for optional use in Table I.

The dashed line posterior to M+Cu in the drawings represents a concave furrow that is probably Cu_2. This may or may not be the vannal fold of Snodgrass (1935).

The dacnusine genus *Agonia* seems to have lost cross-vein 2r, and R_s joins the stigma directly (see Nixon, 1943, Fig. 5).

TABLE I

TERMINOLOGY OF BRACONID WINGS

Actual:	Suggested for use in descriptions:
C+Sc+R	C
R_1	R_1
2r	r
1st segment of R_s	base of R_s*
2nd segment of R_s	1st segment of R_s
3rd segment of R_s	2nd segment of R_s
R_s+M&M	R_s+M
2r—m&R_s	1r—m
3r—m	2r—m
M+Cu_1	M+Cu
1st segment of M	base of M*
2nd segment of M	1st segment of M
3rd segment of M	2nd segment of M
4th segment of M	3rd segment of M
m—cu	m—cu
1st segment of Cu_1	1st segment of Cu
2nd segment of Cu_1	2nd segment of Cu
3rd segment of Cu_1	3rd segment of Cu
Cu_{1a}	Cu_{1a}
Cu_{1b}	Cu_{1b}
cu—a	cu—a
1st segment of 1A+2A	1st segment of A†
2nd segment of 1A+2A	2nd segment of A†

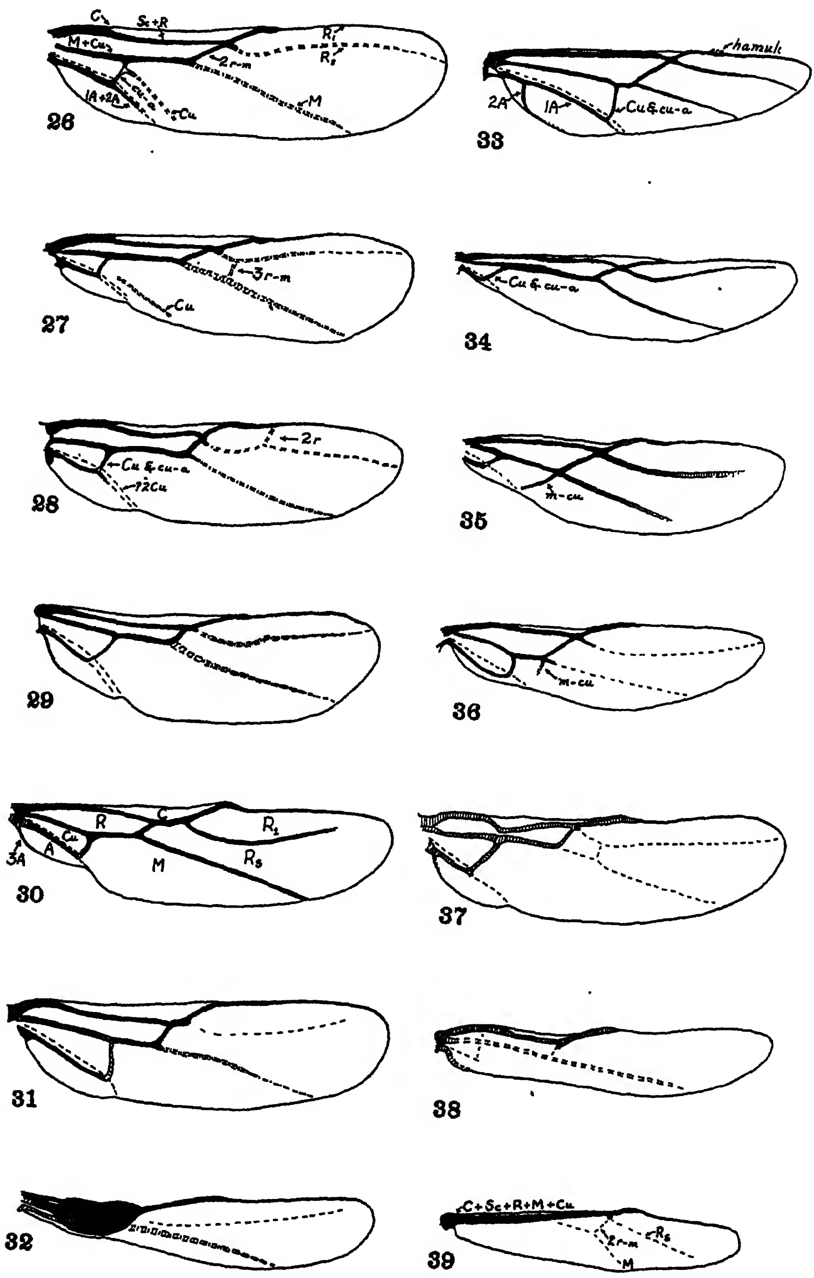
*When R_s+M&M is atrophied (as in Figs 10 and 24), R_s&M (=base of R_s and base of M) might be called the "basal vein" as it has been in the past.

†For use in wings where 2A does not branch off separately (see Figs. 2, 13, 15, etc.).

In Fig. 26 the veins of the hind wing are labeled. The cross-vein given as 2r—m is probably that and not 1r—m, as 1r—m seems to be absent from the cephids, which are probably the closest relatives of braconids among the sawflies (see Ross, 1937, Fig. 175). Note that in *Crassomicrodus* (Fig. 26) and *Bracon* (Fig. 27) part of Cu is preserved.

EXPLANATION OF PLATE IV

Hind Wings. Fig. 26. *Crassomicrodus divisus* (Cresson). Fig. 27. *Bracon haematodes* (Brullé). Fig. 28. *Cardiochiles* sp. Fig. 29. *Chelonus annulipes* Wesmael. Fig. 30. *Aridelus fisheri* (Viereck). Fig. 31. *Ichneutes* sp. Fig. 32. *Heterospilus languriae* (Ashmead), male. Fig. 33. *Helcon dentipes* Brullé. Fig. 34. *Atanycolus simplex* (Cresson) (Vipiinae). Fig. 35. *Alysia ridibunda* Say. Fig. 36. *Symphya ringens* (Haliday) (Dacnusinae). Fig. 37. *Microplitis melianae* Viereck. Fig. 38. *Diaeretus rapae* (Curtis). Fig. 39. *Paxylomma* sp.


C
Sc+R
R_1
R_s
M+Cu
2r-m
M
1A+2A
cu-a
Cu
26
hamuli
2A
1A
Cu & cu-a
33
3r-m
Cu
27
Cu & cu-a
34
2r
Cu & cu-a
?2Cu
28
m-cu
35
29
m-cu
36
R
C
R_1
Cu
3A
A
M
R_s
30
37
31
38
32
C+Sc+R+M+Cu
2r-m
R_s
M
39

In *Aridelus* (Fig. 30) 3A is faintly represented. *Helcon* (Fig. 33) shows the branch of 2A as in the front wing of that genus. In some species 2r (Fig. 28) and 3r−m (Fig. 27) yet remain as slightly pigmented lines, while some alysiines (Fig. 35) and dacnusines (Fig. 36) still have a stub of m−cu. The different position of Cu&cu−a in the various wings is interesting (compare Figs. 31 and 34).

In this system the nomenclature of the cells in both the front and hind wings is very simple (see Figs. 7, 12, and 30).

The wings of braconids often show secondary sexual characters. In the genus *Oenonogastra* (Alysiinae) the stigma of the male (Fig. 19) is much more prominent than that of the female (Fig. 20), and this condition occurs in several other genera. In many species all the wing veins are heavier in the males than in the females. In some species of *Heterospilus* (Hormiinae) (Fig. 32) the males bear a large stigma in the basal area of the hind wing. This is also true of some hecabolines. (See Wilkinson, 1929, for a figure of the hind wing of *Hecabalodes anthaxiae* Wilk., male). Stelfox (1941 and 1944) has illustrated a species of *Phaenocarpa* (Alysiinae) in which there is a long, heavily sclerotized stigma in the anal area of the front wing of the male, and a similar species has been found in America (Fig. 25).

The membrane of braconid wings is usually covered with minute setae. While the membrane is ordinarily rather hyaline, in some cases it is colored, usually shades of brown, although many tropical forms have patterns of brighter color such as orange. Hoffmeyer (1932) has discussed and figured the sensilla that occur on the stigma and veins of hymenopterous wings, giving many examples from the Braconidae. A few braconids are wingless in both sexes, and some species are subapterous in one sex or the other, usually in the females.

Several braconid subfamilies are not represented in the figuers, but their venation will be comparable to one of the types shown.

The presence or absence of the various cross-veins and segments of veins has often been used in the family as the primary character for the separation of closely allied genera and subfamilies. As we learn more about these insects and investigate other structures more fully, it becomes increasingly clear that such wing characters must be used with caution. One example in the case of genera will suffice. The alysiine genus *Synaldis* is separated from *Aspilota* (Fig. 21) by the absence of the 1st segment of R_s, but I have found specimens where this vein is partially present (Fig. 22). Investigation of other characters has shown that the two genera probably will have to be recombined.

Muesebeck (1928 and 1936) already has combined several subfamilies that were separated mainly on the presence or absence of 3r−m. These were the Sigalphinae and Cheloninae, the Euphorinae and Meteorinae, and the Alysiinae and Dacnusinae.

Of course if such characters do not intergrade they probably will be retained as useful key characters. The subfamilies above might be treated as tribes. In many cases it would seem that, in the braconids at least, if two genera are separated *solely* by the presence or absence of a segment of a vein, they should be called subgenera rather than genera. This is not intended as an inflexible rule, but rather indicates that such differences in venation may have little or no fundamental phylogenetic significance.

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NOTES ON THE APACHE WASP[1] IN CALIFORNIA

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Fig growers in the vicinity of Fresno, Calif., have reported injuries to harvest workers by wasps that build their nests in the fig trees. Stinging of workers is especially likely to occur in September and October, when the trees are shaken with long-handled hooks or are jarred with padded bumping poles to dislodge the figs. At that time the wasp colonies are large, and because the daytime temperatures are still high, the insects are active and aggressive when disturbed

As the wasps are locally a perennial nuisance, the writers decided to make observations on their life history. Collections of the single-layered paper combs were made at intervals of about a week from April 21 to June 23, 1945, and from April 17 to May 15, 1946. Two hundred seventy-four nests were removed from fig trees and records were made as shown in Table I.

Nests or combs.—Construction of the combs begins at about the time the leaves of Calimyrna fig trees are an inch or two long. It is done, presumably, by fertilized overwintered females; however, this point was not investigated. As a rule from two to six wasps cooperate in the work of building the nests in the spring. Very small nests are the domiciles of only one or two wasps; larger ones harbor six or seven. The location favored by this species is at the top of the low trees.

Gathering of the small combs during the spring and early summer was done without much danger of being attacked. With the handle of an insect net the collector rapped on the limb bearing the nest, causing the insects to fly away or to circle briefly in the air nearby Before they returned, the comb was scraped off with the rim of the net, into which it would usually fall. Frequently the nests were picked off by hand after the wasps had been scared away.

The wasps usually returned to the nest location and clustered there, sometimes for several days. New nests were often built within a week in trees from which all combs had been removed. Four was the maximum number of small nests found in a tree at one time.

Construction usually begins with a single cell on a slender pedicel (Plate I, A), although some nests appear to have been started as a pair of cells on a single stalk. Other cells are built onto the original cell or cells. As the comb increases in size the cell walls are built higher, the pedicel is strengthened, and the base of the comb is thickened progressively.

[1]*Polistes apachus* Sauss., family Vespidae. Two lots of these wasps were identified by H. K. Townes in September, 1944, and July, 1945

A. *Polistes apachus* nest on a first-crop fig, showing construction of the first cell of a comb. B. Small nest of Apache wasp, with eggs. C. Nest showing eggs and deposits of honey. D. Large larvae of Apache wasp, nearly ready to seal cells. All six larvae in focus are facing inward. E. Cells capped with silk by larvae. F. Apache wasp feeding on honey.

In small nests consisting of up to 20 cells, each cell measures 4 to 5 mm. inside diameter. In some combs the hexagonal shape of the cells is likewise evident in the outline of the comb. Many combs are of course irregular, but the six-sided character of others is readily apparent.

A comb 1 inch in diameter contains about 30 cells. An hexagonal nest 5 inches in diameter is perhaps an average maximum size and contains about 320 cells. Combs as large as 6 by 7½ inches occur. A considerable number of old nests persist on the trees through the winter, or longer.

Most nests are attached to small branches, but large branches may be chosen, sometimes within 4 or 5 feet of the ground. Occasionally small combs are built on green figs. None has been found on the blades of leaves, but one was attached to a leaf petiole. A common location is inside the paper bags that are fastened to the trees for holding caprifigs.

The material used for making the nests is of various shades of gray, usually dark gray, but in small nests the paper is sometimes very light in color. Bands of contrasting shades can often be seen. The source of the woody material gathered and processed by the wasps has not been determined, but scarified areas on the weathered paper of old caprification bags suggest that the bags provide some of the raw material.

Adults confined in a glass-topped box in the laboratory and provided with a small nest, green blotting paper, honey, and water did not reproduce, but they used the blotting paper for making green additions to some of the walls of the nest.

Food storage.—Drops of sweet materials, "honey", were found in some of the cells, beginning early in the season. Occurrence of the drops was very irregular, some nests containing many and others none. The drops were of various colors, consistencies, and flavors. Some were clear and soft (Plate I, C), and tasted like honey; some were amber; others were white, opaque, and firm; still others appeared to be black; all were sweet. The dark material, in texture like caramel candy, was deep purple when examined under a microscope. Its flavor was like that of blackberries.

On a few occasions a small wasp larva was seen with its head immersed in a drop of soft honey.

Data show that "honey" was most plentiful when eggs and young larvae of the first brood occupied the combs (Table I).

The group of wasps held in confinement, as described above, used a part of their ration for storing drops of honey in the cells of the nest.

Eggs.—Laying of eggs begins when there are only two or three cells in the combs. The white eggs (Plate I, B) are glued at one end to a side of the cell, near the base, and in small nests they usually are attached to the cell surface nearest the center of the comb (Plate I, C). As the central area of the comb becomes occupied by developing brood, cells are added to the periphery. These new ones are used for further oviposition. On rare occasions two eggs are deposited in a cell.

In the spring of 1945 eggs were first observed in new nests on April 17. A search of old nests at that time revealed only one with eggs, but the following year old nests were rather commonly utilized by the wasps. A few new nests containing eggs and small larvae were collected in 1947 on April 17.

Larvae.—Newly hatched larvae are held to the cell wall by the eggshell in which they developed. White at first, they assume a pinkish cast as they increase in size, but later the rosy color disappears. For a time the larvae may be compared to the clapper in a bell; the process by which they accomplish molting without falling out of the cell would be interesting to follow through. When fully grown (Plate I, D) and filling the cells snugly, their upsidedown life seems less precarious. Only an occasional large larva falls out when a nest is knocked to the ground.

TABLE I

CONDITIONS FOUND IN NESTS OF THE APACHE WASP COLLECTED FROM FIG TREES IN 1945 AND 1946

Date	Number of Nests Examined	Average Number per Nest							
		Cells	Eggs	Larvae			Capped Cells	Cells with Honey[3]	Drops of Honey
				Small	Medium	Large			
1945									
April 21	21	5.4 (2–16)	5.3	0	0	0	0	0.3	0.3 (0– 4)
27	22	9 5 (3–32)	9.4	0	0	0	0	1.4	1.5 (0– 8)
May 5[2]	12	20.4 (6–34)	14.7	3	1.9	0	0	2.8	3.2 (0–11)
5	15	14.1 (1–23)	11.0	2	0.7	0	0	4.3	5.0 (0–18)
12	30	22.5 (3–47)	8.4	7.4	3.2	2.8	0	1.1	1.6 (0–14)
21	17	22.9 (3–46)	7.0	4.8	3.2	3.2	0.8	0.1	0.1 (0– 1)
28	20	19.6 (7–38)	6.6	2.8	3.0	2.6	1.0	1.5	2.2 (0–21)
June 4	16	23.7 (8–49)	14.5	1.7	1.2	2.4	0.3	0.3	0.3 (0– 3)
12	9	29.0 (10–50)	13.5	1.8	2.9	1.1	0.8	2.3	3.2 (0–16)
23	12	26.0 (5–68)	9.9	3.1	4.3	0.4	3.7	1.5	1.7 (0–13)
Total	174								
1946									
April 17	25	8.8 (2–21)	8 2	0	0	0	0	0.2	0.2 (0– 2)
24	36	15.7 (3–29)	15.2	0	0	0	0	4.6	6.0 (0–24)
May 1	15	21.0 (10–42)	17.3	3	0	0	0	1.5	1.8 (0–11)
15	24	26.2 (6–48)	12.0	4.7	4.8	2.9	0.8	0.5	0.5 (0– 5)
Total	100								

[2]From rows of fig trees cleaned of nests on April 21.
[3]All deposits of sweet materials are listed as "honey."

Fully developed larvae close their cells with a cap of white silk (Plate I, E). Some caps are flat and others dome-shaped. Judging from the data in the table, larvae appear in the spring 14 days or more after eggs are laid. They begin to cap their cells about a month after egg deposition starts.

Adults.—Apache wasps (Plate I, F) are attractively colored insects, golden brown with conspicuous markings of light yellow, with smoky-amber wings, and with grey or black eyes. They vary in length, the largest being about seven-eighths inch long.

On warm days these wasps are commonly seen cruising around fig trees at a height of 10 or 15 feet above the ground. They are rendered

inactive by even moderately cool weather. When fig trees are jarred early in the morning in September, the wasps fall to the ground and may be seen crawling toward the trunk of the home tree.

In the orchard where most of our observations were made, nests of the Apache wasp were most plentiful along the north and east sides, next to an irrigation ditch. On August 11, 1944, twenty trees along the north edge contained 22 nests; about three-quarters of them were inhabited.

When a nest is removed in September, the adults return to the nest site and cluster there for weeks without rebuilding.

Few observations on the sexes were made. By July 17, 1945, males had emerged from nearly all nests held in the laboratory for observation.

The adults confined in a glass-topped box, mentioned above, lived on a diet of honey and water for not more than about 75 days, from about July 7 until September 20.

Natural enemies.—One species of parasite, identified by H. K. Townes as *Polistiphaga fulva* (Cr.), family Ichneumonidae, emerged in the laboratory from a nest collected on a building in a residential district of Fresno. A total of 15 specimens emerged from the comb, which contained numerous capped cells.

Damage to combs in fig trees was quite common on May 21, 1945. Remains of wasp larvae in damaged combs, and the irregular tearing of the paper cells suggested the work of birds. Some combs were found that had been stripped of cell walls, leaving only their thickened bases.

Control.—Attempts were made in the spring to attract the adults to baits in order to reduce the numbers before nest-building began. Beef liver, honey, and sweet ant poisons were tried without success. Sticky boards baited with honey and hung in the trees were likewise unattractive.

Burning the nests with a solid fuel, known as Heatabs, was tried. The tablets were placed in a can attached to a pole, ignited, and the alcohol-like flame was held under the nests. Some adults and brood were killed, but the nests smoldered instead of burning. Some of the larvae which remained in scorched nests were able to cap their cells.

Dust containing 10 percent DDT was applied liberally to nine nests on August 22, 1947, by means of a hand duster equipped with an 8-foot extension tube. Four days later six of the nests were free of adults. When dusted nests were held in the laboratory, it was found that emergence from capped cells continued without apparent handicap from the dust, but that the newly emerged wasps died within a few days.

Distribution.—C. F. W. Muesebeck reported that the species "is common in Texas and also occurs in Kansas, Colorado, Arizona, New Mexico, Iowa, southern Utah, and Mexico, but we have had no specimens previously from California."

Richard M. Bohart, of the University of California at Davis, in August 1946 requested specimens of the Apache wasp and of its nests. In his acknowledgment Professor Bohart stated that he had recently found a few other California records of the species in the collection of the California Academy of Sciences. These records were Bakersfield, Mill Creek in the San Bernardino Mountains, and Needles.

NOTES ON THE PHLEBOTOMUS OF PANAMA (Diptera, Psychodidae)

IV. P. ATROCLAVATUS KNAB, P. CAYENNENSIS FLOCH AND ABONNENC, P. CHIAPANENSIS DAMPF AND SOME RELATED FORMS FROM THE WEST INDIES AND MEXICO[1]

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With the exception of *P. atroclavatus*, the species treated in the present paper share the character, unusual for New World *Phlebotomus*, of a comb-like row of cibarial teeth. *P. chiapanensis* Dampf, if we have correctly associated the sexes, belongs to a group including *P. stewarti* Mangabeira and Galindo, *P. vexator* Coq., *P. trinidadensis* Newstead and a number of others, to which Barreto (1946, Rev. Brasil. Biol., 6(3): 427–434) has recently given a key. Of the known females of this group none have a comb-like cibarium, although with certain marked exceptions, the spermathecae are of a type rather similar to those of *chiapanensis*.

P. ctenidophorus n. sp. is the most bizarre in respect to the cibarial comb, but unfortunately the male is unknown and nothing can be said of its possible relationships.

P. cayennensis is the first recorded species of American *Phlebotomus* to show well-marked geographic races, and two of these subspecies constitute the second known occurrence of *Phlebotomus* in the West Indies. The male genitalia of this complex are quite simple and offer few clues to possible relationships with other American species. *P. cayennensis* and its subspecies seem the closest of any New World *Phlebotomus* to the widespread *minutus* group of the Old World, though there are many points of difference.

Phlebotomus atroclavatus Knab

Plate I, Table I

1913, Ins. Ins. Mens., 1: 135–137, fig. 1 (2♂, 3♀; Gasparee Island, Trinidad, B. W. I.). Larrousse, 1921, Etude Syst. et Med. des Phlebotomes, p. 7. Dyar and Nunez Tovar, 1927, Ins. Ins. Mens., 14: 154. (Venezuela.) Costa Lima, 1932, Mem. Inst. Osw. Cruz, 25 (1): 29. Bequaert, 1938, Carnegie Inst., Washington, Pub. No. 499, p. 230. Floch and Abonnenc, 1943, Inst. Past. de la Guyane, Pub. No. 62, p. 6 (in key). Barretto, 1947, Arq. Zool. S. Paulo, 5 (4): 186. Dampf, 1947, Rev. Ent. 18 (3): 296–305, figs. 1–7.

Phlebotomus (*Sergentomyia*) *atroclavata*, Franca and Parrot, 1921, Arch. Insts. Pasteur de l'Afrique du Nord, 1: 284.

Phlebotomus (*Neophlebotomus*) *atroclavatus*, Dyar, 1929, Amer. J. Hygiene, 10 (1): 120.

[1]This work was initiated under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and the Gorgas Memorial Laboratory. Cost of publication is paid by the Gorgas Memorial Institute.

Phlebotomus tejerae Larrousse, 1921, Etude Syst. Med. des Phlebotomes, p. 71; 1922 Bull. Soc. Zool. France, 47: 41. Nunez Tovar, 1924, Mosq. y Phlebot. de Venezuela, p. 42 (♂, Venezuela). Galliard, 1934, Ann. Parasit. Hum. Comp., 12: 197–199, fig. 2. (Types ♂, ♀.)
Phlebotomus guadeloupensis Floch and Abonnenc, 1945, Inst. Pasteur de la Guyane, Pub. No. 96, pp. 1–3, fig. 1 (♂, ♀; Petits Abymes and Grands Fonds du Moule, Guadeloupe Is., French West Indies, in cavities in trees); 1945, op. cit., No. 100, p. 11. Barretto, 1947, Arq. Zool. S. Paulo, 5 (4): 202.

The Types at the U. S. National Museum consist of a male labelled "Holotype", (actually Lectotype) No. 16850 mounted on a slide and a female No. 16850 also mounted on a slide. The two females and a male preserved dry mentioned by Knab appear to have been subsequently mounted and the male, at least, has been labelled as "Paratype". Other material from Venezuela identified as *atroclavatus*, presumably by Dyar, is also present. Only the Lectotype is actually *atroclavatus*. The female from the type lot as well as several females from Venezuela are *cayennensis* Floch and Abonnenc, a species we have often found associated with *atroclavatus* in Panama and which is discussed in the latter part of this paper. The male "Paratype" and four males from Venezuela are again different, being close to or the same as *trinidadensis* Newst.

TABLE I

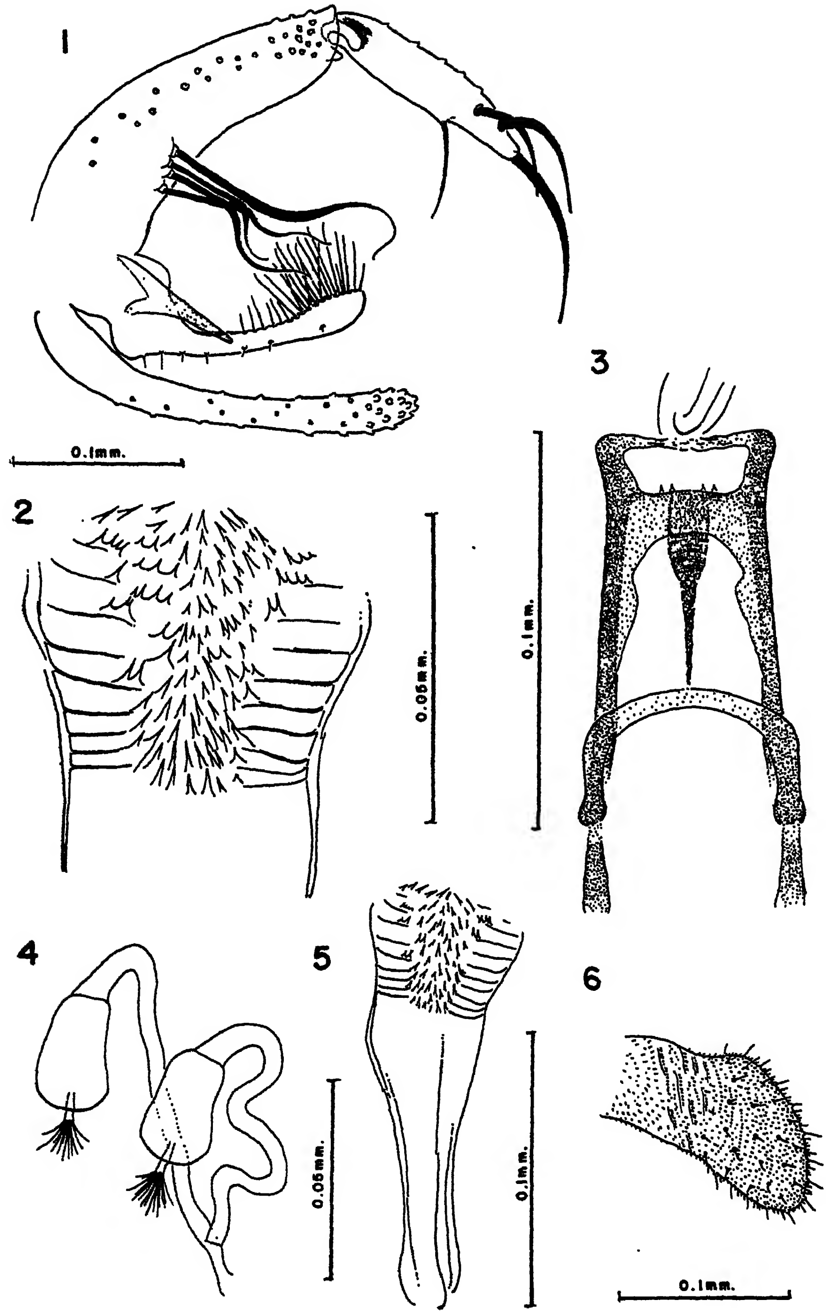
MEASUREMENTS IN MICRA

	P. atroclavatus						*P. chiapanensis*						*P. ctenidophorus*
	Maximum		Minimum		Mean		Maximum		Minimum		Mean		
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♀
Ant. III......	240	228	212	208	228	220	228	220	200	188	213	204	356
Palps I–II....	120	140	100	128	116	133	140	152	124	136	135	145	180
" III.....	148	164	132	148	140	158	152	160	140	152	148	153	184
" IV......	96	112	80	100	88	104	124	124	108	116	115	120	124
" V.......	328	400	240	348	284	377	356	356	272	296	324	328	380
Head height..	224	240	208	212	216	221	232	260	232	240	232	247	288
Clypeus.......	116	120	100	108	108	112	144	160	140	128	141	141	132
Proboscis.....	152	168	152	152	152	160	188	252	160	220	178	234	232
Eye height...	180	168	160	152	168	160	176	192	152	156	165	174	180
Wing length...	1728	1656	1314	1476	1476	1566	1620	1890	1530	1710	1559	1802	2124
Alpha.........	342	468	270	378	306	414	270	342	198	234	227	290	594
Beta..........	288	324	198	270	234	288	252	306	234	288	245	293	306
Gamma......	270	324	198	234	216	270	396	414	342	360	371	392	324
Delta.........	144	252	72	162	108	198	+36	72	−36	−36	5	29	234

The species has been often misunderstood, as Knab's description was quite inadequate, only the styles of the genitalia being correctly

EXPLANATION OF PLATE I

Phlebotomus atroclavatus Knab. Fig. 1. Male genitalia, inner aspect. Fig. 2. Apex of female pharynx. Fig. 3. Female cibarium. Fig. 4. Spermathecae. Fig. 5. Entire female pharynx. Fig. 6. Female cercus.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figured. Knab either failed to see or attached no importance to the basal tuft on the coxite, which is readily visible in his specimen. Floch and Abonnenc's description and figures of *guadeloupensis* are excellent, and the female they associate with the male appears to be the same as the one which we have also concluded was the correct one. Galliard's description and figures of the female cotype of *tejerae* are also in agreement. The description of the male *tejerae* Larrouse we have not seen, though the figure given by Nunez-Tovar of the style is characteristic for the present species and we see no reason for not accepting Dyar's synonymy.

We give here figures of the male genitalia (fig. 1), cibarium (fig. 3), pharynx (figs. 2, 5), spermathecae (fig. 4) and cercus (fig. 6) as well as measurements (Table I) of Panamanian material. The cibarium is quite characteristic, there being a large number of very small erect spines in transverse rows below the four small horizontal spines. These are difficult to see, and even more difficult to portray, as they are obscured by the large pigmented patch. The chitinous arch is well-defined, though poorly sclerotized, and is unusually far distal in position. The genital filaments are rather short, being but slightly longer than the coxite and style and about 3 times as long as the genital pump. The pharynx is quite unique with its evenly spaced transverse ridges, heavy spines, and basal pigmented area. The ascoids are simple, without posterior prolongations, about one third the length of their respective antennal segments in the male, but reaching to the end of the segment in the female.

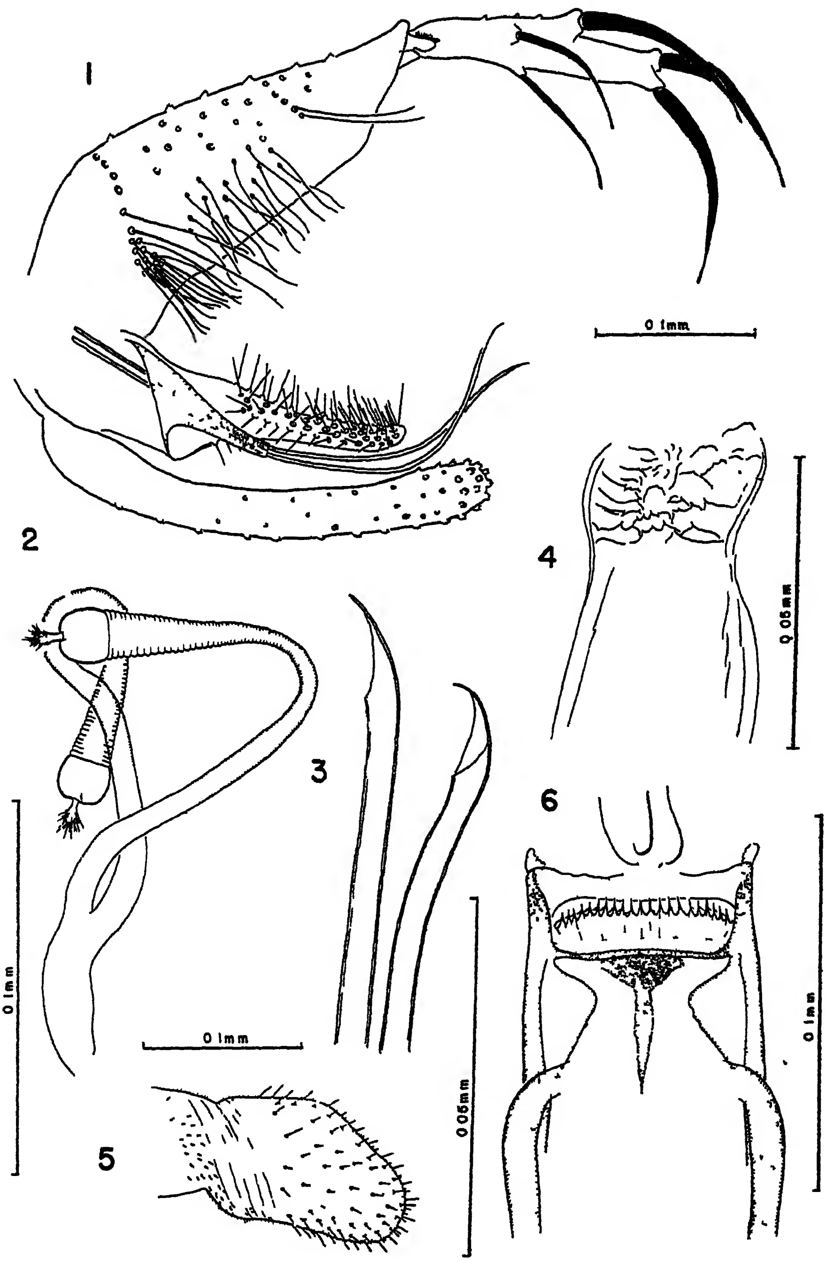
The species is quite abundant in holes and crevices in the walls of the ruins of Old Panama, and we have taken it there in nearly every month of the year. We have also taken it in a wooden building on Chepillo Island at the mouth of the Rio Bayano, on San Jose Island, one of the Pearl Islands in Panama Bay, in a shallow sea cave, and on Taboga Island in tree buttresses. Floch and Abonnenc's material came from hollows in trees on Guadeloupe Island, French West Indies. We have no evidence as to the preferred hosts, but the pronounced maritime distribution is rather striking, all our material having come from islands or from very close to the sea.

The treatment of *cayennensis* and the following three forms as subspecies may seem a bit radical, but we feel that this is the best way to indicate their relationship. The differences noted between them are slight though constant, confined to one sex, and correlated with their geographical distribution. Full specific status for each form is impractical, as the males appear to be indistinguishable, while lumping all four together as a single species ignores the quite definite and constant differences in the females.

The occurrence of *Phlebotomus* in Puerto Rico is of some interest, as it is the second instance of finding the genus in the West Indies

EXPLANATION OF PLATE II

Phlebotomus chiapanensis Dampf. Fig. 1. Male genitalia, inner aspect. Fig. 2. Spermathecae. Fig. 3. Tips of genital filaments. Fig. 4. Apex of female pharynx. Fig. 5. Female cercus. Fig. 6. Female cibarium.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P. atroclavatus, from Guadeloupe is the only other record to our knowledge, exclusive of the species recorded from Trinidad, which is faunistically not part of the West Indies. The occurrence of distinct races on Puerto Rico and Vieques may seem surprising, but insular races in other groups are common enough in the West Indies, and *Phlebotomus* is a rather fragile and sedentary insect. It is probable that other species occur both in Puerto Rico and other of the West Indian islands.

Aside from the typical subspecies, we have no hint as to the habits or preferred hosts of the other races. The West Indian forms were taken in situations similar to those the species selects in Panama. The Mexican material was unaccompanied by any habitat information.

The Guatemalan specimens of the same form were all from buttresses of large roadside trees in relatively open country.

Phlebotomus cayennensis cayennensis Floch and Abonnenc

Plates III, IV, and V, Table II

1941, Inst. Pasteur de la Guyane, Pub. No. 15, pp. 13–17, fig. 5 (♂, Cayenne, Fr. Guiana, in crevices in rocks near the coast); 1943, op. cit., Pub. No. 62, p. 5. Barretto, 1947, Arq. Zool. Est. S. Paulo, 5 (4), p. 192.

Although Floch and Abonnenc describe only the male, they have recently taken females and their description of this sex is to appear shortly. From sketches of the cibarium and spermathecae kindly sent us, there seems no doubt that our species is the same. They also have material from Venezuela.

A small pale brownish species with rather narrow pointed wings, four spines on the style and long fifth palpal segment.

Male.—Genitalia simple, as figured, (Pl. III, fig. 1) the genital filaments short and stout, the aedeagus long and slender. Cibarium showing vestiges of the teeth found in the female. Pharynx without the spines of the female.

Female.—Spermathecae, (Pl. V, fig. 3), cibarium, (Pl. IV, fig. 1), pharynx, (Pl. IV, fig. 7), and cercus, (Pl. V, fig. 2), as figured. The unusual structure of the cibarial teeth, lack of chitinous arch and the strong spines in the pharynx are nearly unique among American species of *Phlebotomus*. The teeth in the cibarium number from 16 to 18 and there is a single row of minute erect teeth below. The antennae are also unusually short, the third segment being hardly one-third the length of the palpi. *Delta* is very long, generally exceeding one-half alpha, though Floch and Abonnenc show a shorter *delta* on their material. The ascoids are simple and short, not over half the length of their respective segments in all the forms.

We have taken this species abundantly in holes and crevices of the ruins of Old Panama, where it is probably the dominant species. A small colony was also discovered in a ground-floor concrete-walled bathroom in the senior author's house in the outskirts of Panama City,

EXPLANATION OF PLATE III

Fig. 1. *Phlebotomus cayennensis cayennensis* Floch and Abonnenc, male genitalia, inner aspect. Fig. 2. *Phlebotomus cayennensis puertoricensis*, male genitalia, inner aspect.

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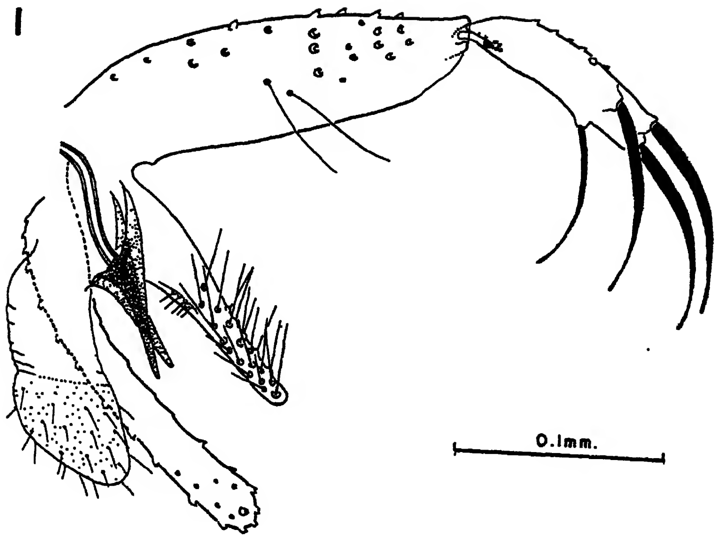

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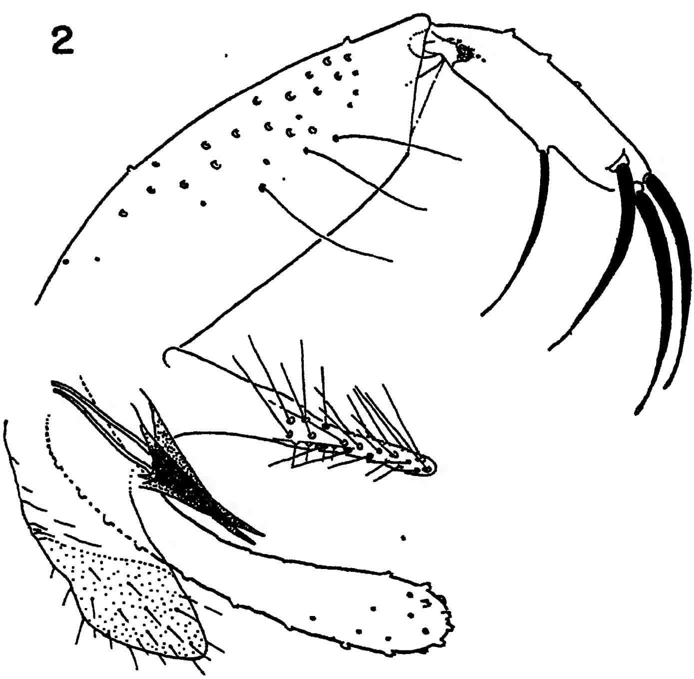


and specimens were repeatedly taken resting on the walls in the darker corners The species has also been taken in buttresses of large trees in heavy forest near Pacora, R P, in a hollow tree in scrubby xerophytic forest near Bejuco, R P, in buttresses of a large tree at La Victoria, near Tocumen, R P at an altitude of about 2400 ft, and in holes and crevices of the ruins of Fort San Lorenzo, at the mouth of the Chagres River on the Caribbean coast The specimen from La Victoria is ten to twenty percent smaller in all measurements than the rest of our material, and we have omitted it from the table of measurements, though we can find no structural differences We believe it likely that the species feeds upon lizards, as these are the dominant vertebrates in its favored habitats Specimens have been taken in most months of the year, but our data are insufficient to indicate seasonal variations in abundance, if any

The female specimens mentioned as being part of the type series of *P atroclavatus*, as well as several from Venezuela in the U S National Museum, are *P cayennensis*, so that Trinidad and Venezuela may be added to the range of the species

P cayennensis does not seem closely related to any described American species *P minasensis* Mang is somewhat similar, but does not have two terminal spines on the style, has a short *delta* and a very short fourth palpal segment *P texanus* Dampf has a very different male with single terminal spine on the style In the female of *texanus* the numerous cibarial teeth seem to be of different structure and there are several rows of erect teeth lacking in our species The spermathecae, though of similar shape, are larger and with shorter ducts, and the cerci are longer and more slender in *texanus* In the structure of the cibarium and pharynx and, to a lesser extent, of the male genitalia, this species approaches the Old World species belonging to the *minutus* group The spermathecae, however, are quite different

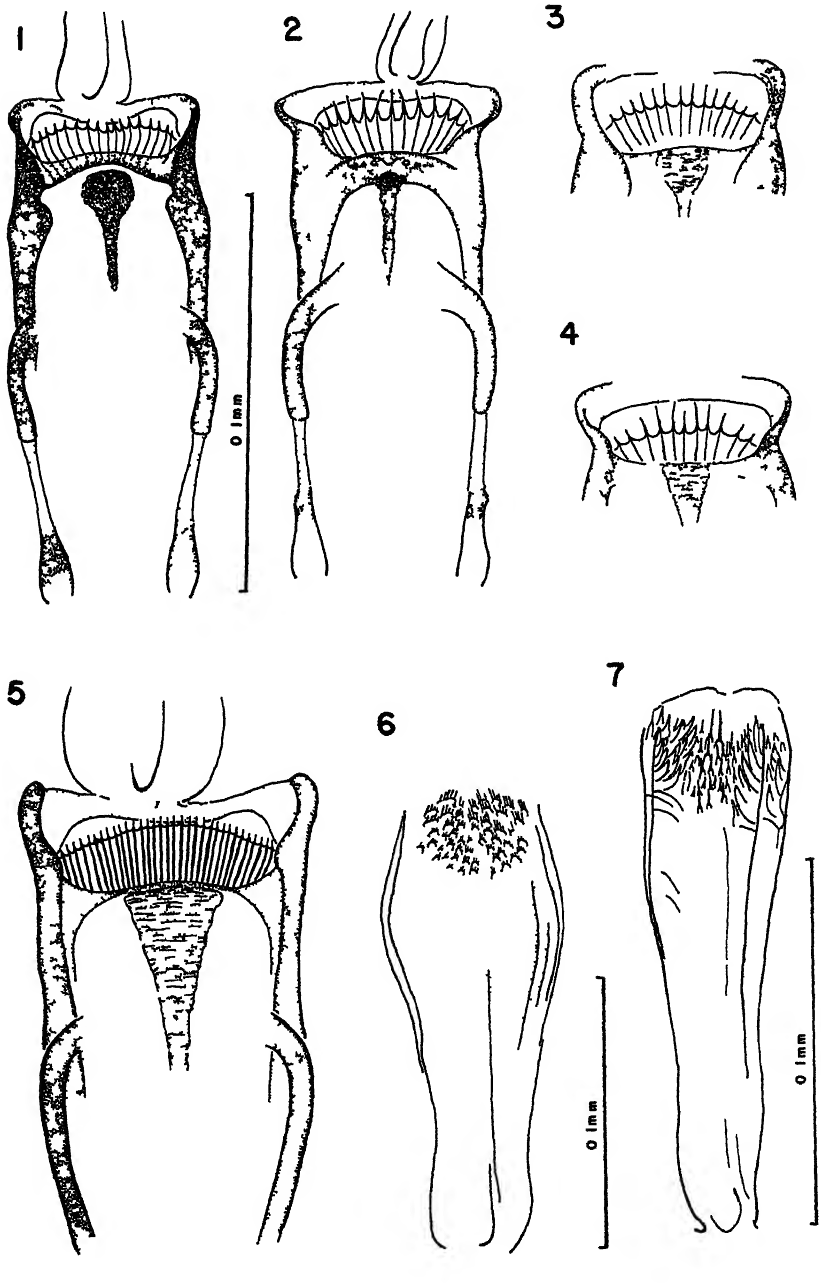
Phlebotomus cayennensis puertoricensis subsp nov

Plates III IV and V Table II

This form differs from the typical subspecies only in details of the spermathecae (Pl V, fig 1), these being smaller, with longer and more slender ducts, and in having fewer (11 to 13) and longer teeth in the cibarial comb (Pl IV, fig 4) We have been unable to detect any erect teeth below Measurements of wings, palpi, etc, average somewhat larger but there is considerable overlapping We have been unable to find any characters in the male which will separate it with certainty from the males of the other subspecies, though we have the impression that the median spine of the style tends to be inserted further distally in this race

EXPLANATION OF PLATE IV

Fig 1 *Phlebotomus c cayennensis* Floch and Abonnenc, female cibarium Fig 2 *Phlebotomus c maciasi* subsp nov, female cibarium Fig 3 *Phlebotomus c viequesensis* subsp nov, cibarial teeth Fig 4 *Phlebotomus c puertoricensis* subsp nov, cibarial teeth Fig 5 *Phlebotomus ctenidophorus* sp nov, female cibarium Fig 6 Same, female pharynx Fig 7 *Phlebotomus c cayennensis* Floch and Abonnenc female pharynx


1
2
3
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6
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Holotype, female.—Slide 1057, Lares, Puerto Rico, 1200 ft. alt., 15 Aug. 1947, in a cave, Jose Romero coll.

Allotype, male.—Slide 1059, same data.

Paratypes.—Two males, same data as holotype; 2 males, 3 females, Lares, Puerto Rico, 3 July 1947, in a hollow "Bucal" tree, H. Trapido and Jose Romero coll.; 3 males, 2 females, Lares, Puerto Rico, 19 July 1947, Jose Romero coll.

TABLE II

MEASUREMENTS IN MICRA

	P. c. cayennensis						*P. c. maciasi*				*puertoricensis*		*viequesensis*	
	Panama						Mexico		Guatemala		Puerto Rico		Vieques Id.	
	Maximum		Minimum		Mean		Mean		Mean		Mean		Mean	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
Ant. III..	196	200	172	152	194	178	198	182	194	192	200	227	214	200
Palpi I–II	128	128	108	112	119	121	120	123	117	120	130	134	122	120
" III.	132	140	116	112	125	128	136	134	124	133	144	149	132	138
" IV..	112	112	96	100	105	106	98	100	93	103	104	114	101	98
" V...	340	336	272	273	304	302	300	321	268	313	310	336	298	310
Head ht..	216	240	208	212	211	227	212	234	205	214	224	234	224	220
Clypeus..	128	140	112	108	122	126	140	125	113	130	115	129	136	138
Proboscis.	168	188	132	152	152	173	168	185	145	180	152	169	146	166
Eye ht...	184	200	160	160	165	186	172	185	168	174	174	190	164	......
Wing.....	1548	1764	1404	1494	1461	1643	1584	1660	1450	1640	1631	1899	1512	1710
Alpha....	378	486	324	324	343	428	405	479	396	468	396	504	414	......
Beta......	306	342	234	216	264	283	279	324	234	277	290	355	234	......
Gamma..	216	234	144	162	165	193	198	191	185	218	225	252	180	......
Delta.....	216	324	162	180	189	264	279	335	253	306	230	301	234	......

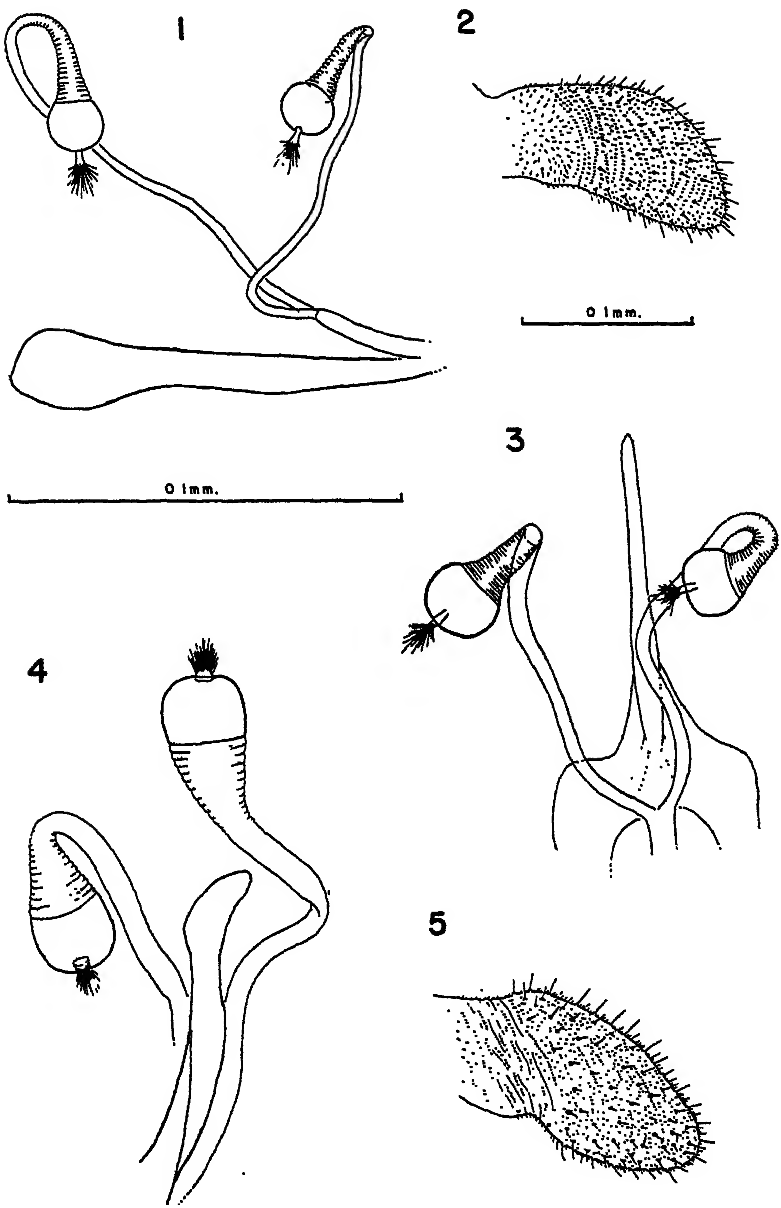
Phlebotomus cayennensis viequesensis subsp. nov.

Plates III, IV, and V, Table II

This form differs from the typical subspecies only in the structure of the spermathecae (Pl. V, fig. 4) and cibarium (Pl. IV, fig. 3) of the female. The spermathecae are considerably larger, with shorter and thicker ducts, and the cibarial teeth are longer and fewer in number. There are also four minute erect teeth in two sublateral pairs. From *P. c. puertoricensis* it differs especially in the much larger spermathecae. The cibarium also appears to have a few more teeth, 14 and 15 in the

EXPLANATION OF PLATE V

Fig. 1. *Phlebotomus c. puertoricensis* subsp. nov., spermathecae. Fig. 2. *Phlebotomus cayennensis* Floch and Abonnenc, female cercus. Fig. 3. Same, spermathecae. Fig. 4. *Phlebotomus c. viequesensis* subsp. nov., spermathecae. Fig. 5. *Phlebotomus ctenidophorus* sp. nov., female cercus.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two specimens available, but a larger series of specimens might not substantiate the slight differences indicated. This race seems smaller than the Puerto Rico form, the few measurements available showing no differences from *P. c. cayennensis*.

Holotype, female.—Slide 1051, Laguna Yanuel, Vieques Island, Puerto Rico, 17 June 1947. In a tree hole. H. Trapido and J. Andrews colls.

Paratypes.—Two males, 2 females, same data as holotype; 1 male, Isabel Segunda, Old Spanish Fort, Vieques Island, Puerto Rico, 19 June 1947. H. Trapido coll.

Phlebotomus cayennensis maciasi subsp. nov.

Plate IV, Table II

This form again differs from the typical subspecies only in characters of the female. The spermathecae are like those of the Panama subspecies, but the cibarial comb (Pl. IV, fig. 2) has much longer teeth, which tend to be fewer in number, 12 to 13 in Mexican examples, 12 to 16 in those from Guatemala. The erect teeth below the cibarial comb are larger than in Panama specimens, and the central pair are markedly larger than the others. In measurements there seem no significant differences between material from Mexico, Guatemala or Panama, though *delta* seems to average shorter in Panama material.

Holotype, female.—Slide 931, Zumpango, Guerrero, Mexico, Macias coll.

Allotype, male.—Slide 390, between Esquintla and San Jose, Guatemala, June 3, 1945, G. B. Fairchild coll. Taken in buttresses of a large roadside tree.

Paratypes.—Three males, 10 females, Zumpango Guerrero, Mexico, Macias coll.; 1 male Guerrero, Mexico; 2 males, near Esquintla, Guatemala, May 25, 1945, in buttresses of large forest trees; 2 males, 5 females between Esquintla and San Jose, Guatemala, June 3, 1945, in buttresses and hollow trees along roadside.

Phlebotomus ctenidophorus sp. nov.

Plates IV and V, Table I

We have only a single female of this species, but the structure of the cibarium (Pl. IV, fig. 5) is so unusual that we feel it should be recognizable from that alone. The cibarium is a comb-like structure bearing 34 fine teeth, the pharynx (Pl. IV, fig. 6) is armed with prominently sclerotized tubercles each bearing a row of fine spines and shows in addition a heavily pigmented patch anterior to the spines. The cerci (Pl. V, fig. 5) are of a somewhat different shape from those of *cayennensis*. The spermathecae are unfortunately badly shrunken, but appear to have been subglobose with relatively short ducts. The third antennal segment and fifth palpal segment are both quite long, while *alpha* is very long, much exceeding *beta* or *gamma*. The ascoids are simple and appear not to reach the ends of their respective antennal segments, though in our single mount they are difficult to see.

Holotype, female.—Slide, 999, Tamazunchale, San Luis Potosi, Mexico (no date), Macias coll.

We include this species here, as it seems to be related to *P. cayennensis.*

Phlebotomus chiapanensis Dampf

Plate II, Table I

1947, Medicina, Mexico, 27 (530): 3–7, figs. 1–6 (♀; Chiapa de Corzo, Chiapas, Mexico).

We at first confused this species with *cayennensis* but it is larger and with quite different wing measurements. The spermathecae (fig. 2), though superficially similar to *cayennensis* have a large setiferous knob at the apex, not shown in Dampf's figure. The reticulate appearance of the pharynx (fig. 4), emphasized by Dampf is clear in our material, but in addition there are small spines not shown by him. The cibarial comb (fig. 6) bears about 25 teeth, considerably more than in any of the forms of *cayennensis.* The ascoids are simple and reach nearly to the ends of the segments. Our material shows a shorter *delta* and *alpha* and a longer *gamma* than indicated by Dampf in his figure, but he gives no actual measurements of these vein segments. The late Dr. Dampf was kind enough to compare one of our specimens with the type and agreed that our determination is correct.

We have also taken what we believe to be the male of this species (fig. 1). It agrees in wing and palpal measurements, except for being somewhat smaller, and in well stained material vestiges of the cibarial comb may be seen. It is, however, so unlike the males of *cayennensis* that we were for long hesitant in accepting it as the proper male for the species. It is closely similar in the structure of the style to *P. stewarti* Mangabeira and Galindo, though the basal tuft on the coxite, of relatively slender scattered hairs, is reminiscent of the condition in *trinidadensis* Newst.

We have taken this species in fair abundance in crevices in the ruins of Old Panama, our records showing captures in Feb., April, June, Sept., Nov., and Dec. Dr. Galindo has taken it also at Puerto Chitre, Herrera Prov., Panama. Aug. 9, 1945 in a rodent burrow. We also have a male and a female from Barranca, Costa Rica, H. W. Kumm coll.

ARTHROPODA.—This journal is the official organ of the Asociacion Argentina de Arthropodologia. Its purpose, according to the statement of Sr. Julio A. Rosas Costa, president of the Subcommittee of Publications, is to publish original, unpublished articles on the embryology, morphology, anatomy, histology, physiology, ecology, taxonomy, systematics, zoogeography and palaeontology of arthropods of the Neotropical region, particularly of Argentina. Four numbers are to constitute the annual volume. Number one, volume one, dated November 27, 1947, contains 126 pages of text. It is well printed, except for an occasional defective letter, on a good grade of paper. The articles appear substantial, and the illustrations are good. The articles of the first issue, by F. S. Pereira, E. E. Blanchard, O. Schubart, A. Martínez, A. Ogloblin, F. Monrós, and M. A. Garriker, Jr., deal with the Hymenoptera, Coleoptera, Orthoptera, Mallophaga, and Diplopoda. Short sections are devoted to notes and book reviews. We extend our welcome and best wishes to our Argentine coworkers.—M.T.J.

LARVAL, PUPAL, AND ADULT STAGES OF NORTH AMERICAN PHYSONOTA

(Chrysomelidae)

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Illinois Natural History Survey,
Urbana, Illinois

The tortoise beetle genus *Physonota* Boheman in North and South America contains about forty species of which four or five are known to occur north of Mexico. Two of these are from the Southwest, one is recorded from California, and two occur chiefly in the East, Middle West, and eastern Canadian provinces. Representatives of four of these species have been studied.

A study of the larvae, pupae, and adult male and female genitalia has disclosed several characters which aid greatly in the recognition of our species. The study has also resulted in the clarification of the status of certain doubtful forms and has pointed out previously unrecognized relationships among our species.

Physonota unipunctata (Say) was the only species recognized in our fauna for many years, but Hamilton (1886) believed that *5-punctata* Walsh, a synonym of *helianthi* Randall, was also distinct and not a synonym of *unipunctata*. Caulfield (1884, 1886, and 1887) also believed *unipunctata* and *helianthi* were distinct. Barber (1916) suggested that *unipunctata* was probably divisible into a number of more or less distinct forms restricted to certain food plants. Criddle (1926) considered *unipunctata* and *helianthi* distinct because each had a different host. Some adult differences were described.

Through field observations and collections, and subsequent study of larvae, pupae, and adults, I have confirmed the opinions of others that *unipunctata* and *helianthi* are distinct species. They feed on different hosts, *unipunctata* on *Monarda* and *helianthi* on *Helianthus;* there are striking larval and pupal differences; and features of the male and female genitalia associate *unipunctata* with *alutacea* Boheman, and *helianthi* with *arizonense* Schaeffer. This association is also borne out by larval characters, and in pupae of three of the four species.

I am indebted to Dr. E. A. Chapin, United States National Museum, and Dr. W. H. Anderson, Bureau of Entomology and Plant Quarantine, for submitting adult, larval, and pupal material of *Physonota* for study.

CHARACTERS OF PHYSONOTA

Physonota adults known from north of Mexico have the head completely covered by the rounded pronotal margin. All the tarsal claws are simple and without basal teeth. The anterior margins of the elytra are finely crenulate, the third antennal segment in our species is distinctly longer than the second. From *Psalidonota* Boheman, it differs in not having the elytra ridged behind the scutellum, and by having the pronotum widest near base instead of in front of middle. *Physonota*

is also related to *Cassida* L. but does not have the strong pronotal punctures found in that genus, and the lateral pronotal margins of *Physonota* are not angulate.

The *Physonota* larvae studied have the mesothoracic spiracle situated below the level of the lateral thoracic spines, and the eighth abdominal segment is without lateral processes. In this feature it is similar to *Eurypepla* Boheman but has much longer caudal forks than in that genus. In *Eurypepla* the caudal fork is shallowly emarginate with each process very short.

Since there has been insufficient pupal material of other cassidiid genera for study, it has not been possible to determine the generic characters for the *Physonota* pupae studied.

KEY TO SPECIES

LARVAE

1. Prothorax with three lateral marginal spines; mesothorax and metathorax each with two marginal spines (figs. 4 and 5) 2
   Prothorax with two marginal spines; mesothorax and metathorax each with one marginal spine (fig. 3) .... **helianthi, arizonense**
2. Thoracic spines rough in appearance, generally directed laterad, and with apical half or more of each black (fig. 4); processes of caudal fork outwardly curved; abdominal tergites with a dark spot near each spiracle; mesonotum and metanotum each with a dark diagonal mark near lateral margin .... **unipunctata**
   Thoracic spines nearly smooth, directed caudad, and with never more than extreme apex of each dark (fig. 5); caudal fork process inwardly curved; mesonotum, metanotum, and first six abdominal tergites with conspicuous transverse bands .... **alutacea**

PUPAE

1. First five abdominal segments each with a long lateral projection, the first four projections at least as long as the segment, as in figs. 7 and 8 2
   First four abdominal segments with short lateral projections, each not more than half as long as segment (fig. 6) .... **helianthi**
2. Projection of first abdominal segment curved forward, the anterior margin dark and concave, posterior margin pale and convex (fig. 8); extreme tips only of projections of following three segments dark; each side of pronotum near middle with a transverse dark bar arising at margin .... **alutacea**
   Projection of first abdominal segment directed forward then slightly recurved, the anterior margin convex and the posterior margin concave (fig. 7); lateral projections of first four segments entirely dark; pronotum pale on sides, the posterior angles dark .... **unipunctata**

ADULTS

1. Abdomen with a broken longitudinal central and lateral dark color pattern (fig. 1); outline of body, seen from side, usually tumid (fig. 2); metasternum raised and strongly declivous on each side of meson before posterior coxae, the lateral side of declivity almost perpendicular, and with angle of ridge usually bearing a small posteriorly directed angular projection .... **alutacea**
   Abdominal sternites nearly uniformly dark to yellow, but with dark areas generally arranged in even transverse bands on anterior margins of sternites II to V; body never tumid; metasternum slightly to rather strongly raised, the lateral sides gradually sloping and without angular projection at apex of ridge 2
2. Abdomen yellow with a short transverse dark mark on each sternite near lateral margin; pronotum with three dark longitudinal marks, the median one four to six times longer than wide .... **arizonense**
   Abdomen entirely dark, or with posterior margins and frequently metacoxal process of sternites pale 3

3 Pronotum with three distinct dark spots, two basal and one median and frequently an occasionally divided dark area in front of median spot elytra often mottled with creamy spots metasternum on side nearly evenly curved from front to posterior margin and scarcely evident as a ridge **helianthi**

Pronotum with a single median dark spot elytra nearly uniformly greyish yellow, unmottled, metasternum on side generally appearing as a distinct ridge **unipunctata**

Physonota helianthi (Randall)

Cassida helianthi Randall (1838, p 30)
Physonota septentrionalis Boheman (1862, p 245)
Cassida quinquepunctata Walsh (1869a p 235)
Physonota quinquepunctata Walsh (1869b, p 4)

Larva (fig 3) —Length 11 mm Prothorax with two lateral spines, mesothorax and metathorax each with one lateral spine, first seven abdominal segments each with a lateral spine, these sometimes absent on first segment and occasionally present on 8th segment In last instar thoracic spines dark at base and apex, but nearly uniformly brownish in earlier instars Spines nearly straight and smooth, and provided with a few hairs, the abdominal spines generally directed caudad Caudal fork subparallel in basal two thirds, each process outwardly curved in apical third Upper surface of body light, lateral margins dark, mesothorax and metathorax generally with two dark discal areas, dark areas on margins of abdomen sometimes united caudally on upper and undersides Head brown, mottled with darker brown, legs brown, apical segment darker, caudal fork of last instar light in basal two thirds, black at apex

Pupa (fig 6) Length 8 mm Upper surface of mature pupa pale yellow except as follows pronotum with a median dark longitudinal spot, a subbassal dark spot about midway between meson and lateral angles, and a transverse slightly sinuate mark arising on lateral margin and extending mesad Wing pad with a single dark band along posterior margin Metanotum with a dark mark on each side First three abdominal segments with short lateral projections, the following two segments with smaller swellings, first six abdominal tergites each with an irregular, medially interrupted transverse band

Adult —Length 8–12 mm , width 6–7 mm General color similar to that of *unipunctata* but differing as follows pronotum with three distinct dark spots, one about the middle and one each in front of basal margin about half way between meson and lateral margin, elytra usually distinctly mottled with creamy yellow spots Scutellum usually wider than long Internal sutural margin of elytra nearly concolorous with elytra Venter similarly colored to that of *unipunctata* Legs nearly similarly colored but posterior face of tibia almost entirely pale, outer margin usually dark Metasternum nearly evenly

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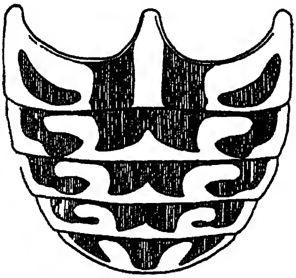
EXPLANATION OF PLATE I

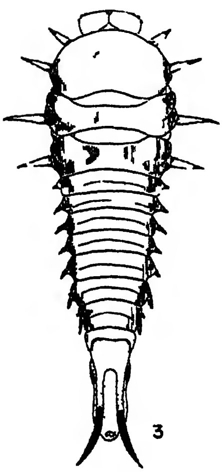
Fig 1 *Physonota alutacea* Abdomen of adult Fig 2 *Physonota alutacea* Lateral aspect of adult from Honduras Fig 3 *Physonota helianthi* Larva, dorsal aspect Fig 4 *Physonota unipunctata* Larva, dorsal aspect Fig 5 *Physonota alutacea* Larva, dorsal aspect Fig 6 *Physonota helianthi* Pupa, dorsal aspect Fig 7 *Physonota unipunctata* Pupa, dorsal aspect Fig 8 *Physonota alutacea* Pupa dorsal aspect (Figs 3–5, legs not shown)



ALUTACEA

2

ALUTACEA



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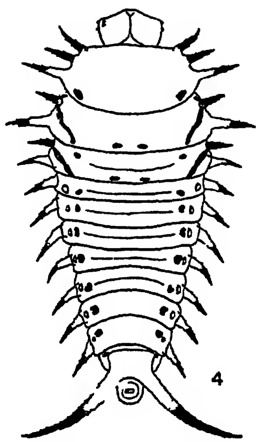
HELIANTHI



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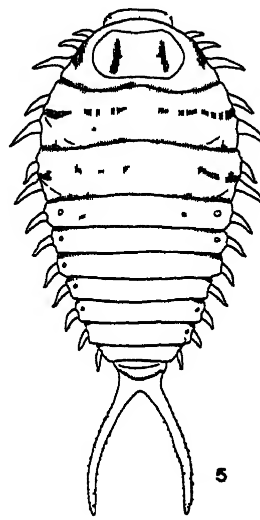
UNIPUNCTATA



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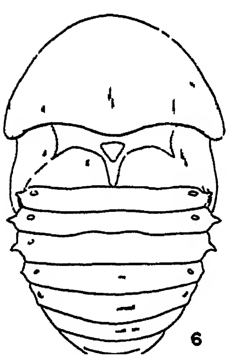
ALUTACEA



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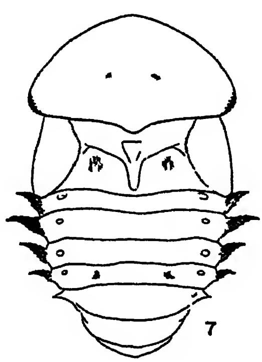
HELIANTHI



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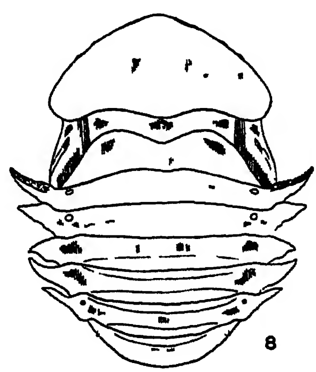
UNIPUNCTATA



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ALUTACEA

curved on side from middle to posterior coxa. Spermatheca of female genitalia (figs. 14 and 14A) not constricted before the opening to spermathecal duct; duct in part parallel to spermatheca and extremely and narrowly convoluted beyond region of spermatheca; bulbous part of spermatheca with a variable collar or sheath; apex of spermatheca blunt and covered internally with a sheath. Two females, one from Illinois, the other from Manitoba, are illustrated to show individual variation. Male genitalia in lateral view (fig. 9) curved, dorsally convex, pointed and slightly upturned at apex. In dorsal view (fig. 9A), apex of aedeagus gradually narrowed. One male collected at Montreal, Quebec, in September is strongly iridescent above. Retracted aedeagus with a long awl shaped process (figs. 9B and 9C).

P. quinquepunctata Walsh was originally described from larvae and adults, collected near Rock Island, Illinois, in a footnote to a paper on sweetpotato insects. Subsequently a fuller description of this insect was given by Walsh (1869b, p. 4), and was accompanied by illustrations of the adult and larva. The figures clearly show the elytral spotting of some individuals of *helianthi*, and the arrangement and shapes of the spines and caudal fork typical of the larva of *helianthi*. I believe *quinquepunctata* is a synonym of that species. An examination of the description of *P. septentionalis* Boheman appears to indicate its synonymy with *helianthi*. The anterior tibia is described as being externally infuscate, a character always found in *helianthi* but not observed in *unipunctata*.

Adults of this species resemble *unipunctata* and the two have been confused in collections. Reference to the descriptive notes under *unipunctata* will aid in distinguishing the two. *P. helianthi* is closer to *arizonense* but is distinguished by having at least the entire anterior margins of abdominal sternites II to V dark. In *arizonense*, these sternites are pale except for a narrow transverse mark near each lateral margin.

Records.—Larvae, June, July, September; pupae, July, September; adults, May to September. Illinois, Indiana, Kansas, Maine, Manitoba, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Tennessee, and Quebec.

Hosts.—*Helianthus*, *Heliopsis*.

Physonota arizonense Schaeffer

Physonota unipunctata arizonense Schaeffer (1925, p. 234).

Larva.—Length 5.5 mm. to base of caudal fork, 8 mm. to apex of fork. One individual believed to be about a third instar, has been examined, and it is of the same type as *helianthi*. The prothorax has two straight spines on each lateral margin, and the mesothorax and metathorax have one each on each side. The first seven abdominal segments have a distinct spine on each lateral margin; the caudal fork is of the same type as in *helianthi*, but the two processes are nearly straight and only slightly curved outwardly at their apexes.

Pupa.—Unknown.

Adult.—Length 11–13 mm.; width 7.5–8.5 mm. Similar in general color to *unipunctata* and *helianthi*. Pronotum with three dark spots, as in *helianthi*, the median spot four to six times longer than wide.

Elytra occasionally faintly mottled with creamy white. Scutellum nearly equilateral. Legs largely pale, sometimes with the outer margin of femur near joint, and outer tibial margin, dark. Metasternum rounded on side and evenly curved as in ***helianthi***. Abdomen pale, the first four segments with a narrow transverse dark mark near each lateral margin. Spermatheca (figs. 15 and 15A) similar in general features to that of ***helianthi***, the two females illustrated differing from ***helianthi*** as follows: apex of spermatheca narrow, not blunt as in ***helianthi***, apical sheath apparently arising close to apex and not enveloping a large part of apex as in ***helianthi***; spermathecal duct very narrow and greatly convoluted as in ***helianthi***, length estimated to be about 50 to 100 times length of spermatheca (only base of duct shown in figures). Two females, from Sabino Canyon, Arizona, are illustrated showing individual variation. Male genitalia very similar to that of ***helianthi*** except dorsally more slender and with the aedeagus process straighter on sides as in fig. 12.

Records.—Larva, July; adults, May, July, August. Tucson, Arizona (Santa Catalina Mts.).

Hosts.—*Franserica ambrosioides*, *Gaertneria xanthocarpa*.

Physonota unipunctata (Say)

Cassida unipunctata Say (1824, p. 434).

Larva (fig. 4). Length 9 mm. Prothorax with three lateral spines, mesothorax and metathorax each with two lateral spines; first seven abdominal segments each with a lateral spine. Thoracic and abdominal spines with at least apical halves dark; surface of spine minutely toothed. Nearly all spines slightly posteriorly curved. Caudal fork divergent from base and with each process straight or generally outwardly curved. Head pale, mouthparts and region of eyes darker; legs pale except outer dark margin of apical segment, and apex of penultimate segment; caudal fork black in apical two-thirds to three-fourths.

Pupa (fig. 7).—Length 8 mm. Upper surface of mature pupa generally pale yellow. Pronotum with a pair of median dark spots, and lateral posterior angles dark and slightly roughened. Metanotum and fourth abdominal tergite each with a pair of dark spots. Lateral projections present on first five abdominal segments, the anterior four dark, minutely tuberculate and somewhat directed forward although each is posteriorly curved.

Adult.—Length 7.5 to 10 mm., width 5–7 mm. Color above varying from pale yellow to brownish grey. Pronotum with a distinct median dark spot slightly behind middle. Scutellum usually longer than wide. Elytra nearly uniformly colored but occasionally with faint, irregular, dark markings. Internal sutural margin usually darker than disc of elytron. Venter usually with more dark areas than light. At least anterior margins of abdominal sternites II to V always dark, with posterior and lateral margins, and frequently metacoxal process of abdomen light. Legs light with an incomplete irregular dark band around middle of each femur, and an irregular elongate dark spot on posterior face of each tibia. Metasternal ridge usually rather suddenly declivous behind. Spermatheca of female genitalia (figs. 13 and 13A) constricted before opening of spermathecal gland (sg); shape like a

broad U, entire apex with a sheath; spermathecal duct (sd) about one third width of spermatheca, not greatly convoluted, and estimated to be not more than ten times length of spermatheca. Two females, both from Apple River Canyon State Park, Illinois, are illustrated to show individual variation; spermathecal duct not shown in one female. The spermatheca of this species is more like that of *alutacea* than the other species considered, being distinctly swollen before the opening into the spermathecal duct. Male genitalia very similar to that of *alutacea*, differing notably by the characters of the process on the aedeagus; process (fig. 11) elongate, rounded at apex, and suddenly expanded dorsally and laterally at base; apex of process in lateral view (fig. 11A), curved dorsad.

The adults of this species and *helianthi* are somewhat similar and have not been satisfactorily distinguished previously. *P. unipunctata* has a single distinct pronotal spot while *helianthi* has three The dorsum of *unipunctata* is of a nearly uniform color, and *helianthi* often has the elytra mottled with cream colored spots. The extreme inner margin of each elytron of *unipunctata*, which appears as a thin horizontal ribbon, is generally darker than the elytra, while in *helianthi* the margin is nearly concolorous with the elytra. The venters of the two species are variable although nearly similarly colored However, each tibia of *unipunctata* bears a dark spot on its posterior face which is absent in *helianthi*. In *unipunctata* the scutellum is usually longer than wide, and not nearly equilateral as in *helianthi*. The metasternal ridge of *unipunctata* is rather suddenly declivous behind and not nearly evenly rounded as in *helianthi*.

Records.—Larvae, June, July; pupae, July; adults, April to August. Colorado, Illinois, Iowa, Kansas, Manitoba, Minnesota, Missouri, Nebraska, North Dakota, Ontario, Pennsylvania, West Virginia.

Host.—*Monarda.*

Physonota alutacea Boheman

Physonota alutacea Boheman (1854, p 191)

Larva (fig. 5). Length 11 mm. from head to base of caudal fork. Prothorax with three lateral spines, mesothorax and metathorax each with two lateral spines, and first seven abdominal segments each with a lateral spine. Spines nearly smooth, light in color with extreme apex usually dark; all spines posteriorly curved, and nearly of equal

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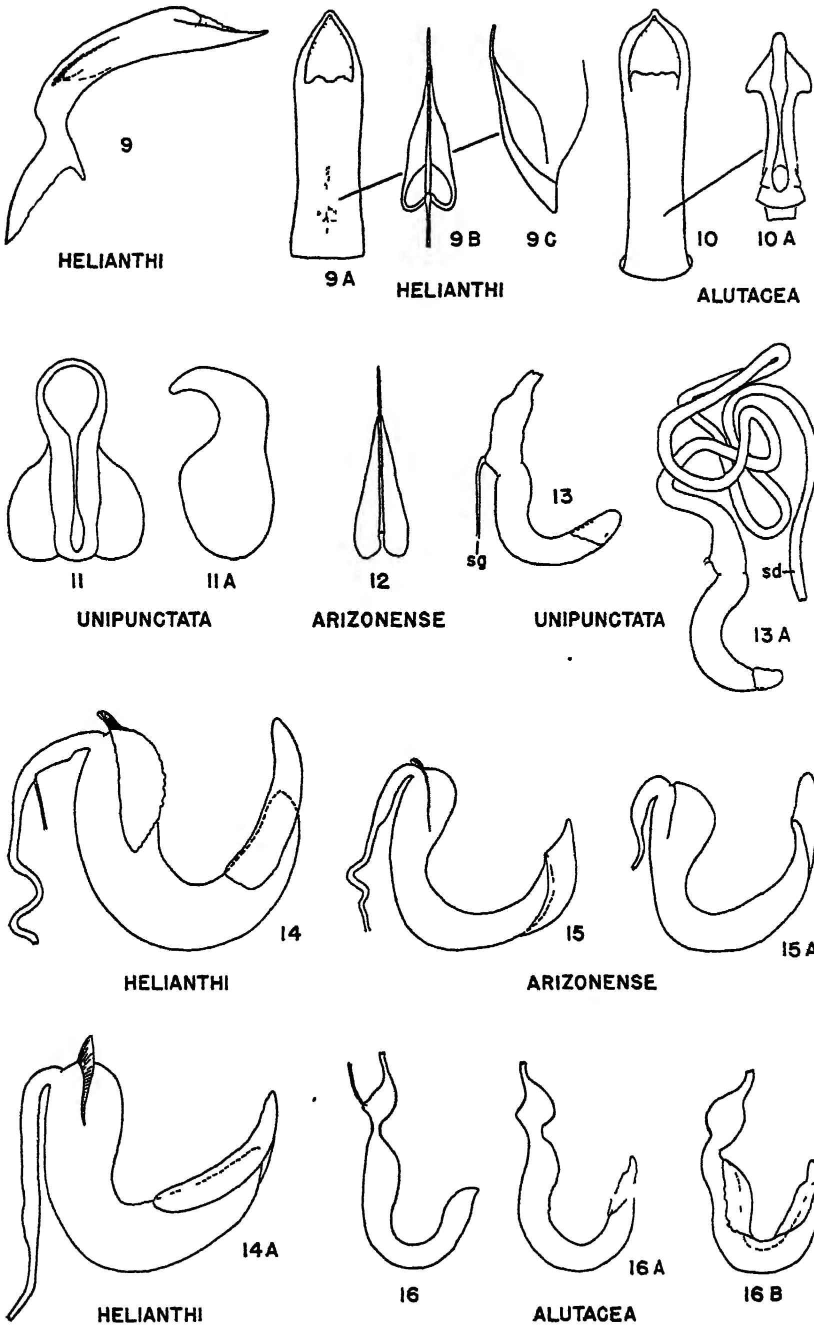
EXPLANATION OF PLATE II

Fig. 9. *Physonota helianthi*. Male genitalia, lateral aspect. 9A—Male genitalia, dorsal view. 9B—Process of aedeagus of male genitalia, dorsal view. 9C—Lateral view. Fig. 10. *Physonota alutacea.* Male genitalia, dorsal view 10A—Process of aedeagus of male genitalia, dorsal view. Fig. 11. *Physonota unipunctata.* Process of aedeagus of male genitalia, dorsal view. 11A—Lateral view. Fig. 12. *Physonota arizonense* Process of aedeagus of male genitalia, dorsal view. 12A—Lateral view. Fig. 13. *Physonota unipunctata.* Female genitalia, spermetheca (from Illinois). 13A—Spermatheca showing convoluted duct (from Illinois). Fig. 14. *Physonota helianthi.* Female genitalia, spermatheca (from Manitoba). 14A—Same from Illinois. Fig. 15. *Physonota arizonense.* Female genitalia, spermatheca (from Arizona). 15A—Same from Arizona. Fig. 16 *Physonota alutacea.* Female genitalia, spermatheca (from Monterey, Mexico). 16A—Same locality. 16B—Same from Texas.


9
HELIANTHI
9 A
9 B
9 C
HELIANTHI
10
10 A
ALUTACEA
11
11 A
UNIPUNCTATA
12
ARIZONENSE
13
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UNIPUNCTATA
sd
13 A
14
HELIANTHI
15
15 A
ARIZONENSE
14 A
HELIANTHI
16
16 A
16 B
ALUTACEA

length except the first two prothoracic pair, which are shorter than the other thoracic spines, and the gradually shorter spines toward the caudal fork. Prothorax with almost the entire lateral and anterior margin dark and with two longitudinal dark discal marks. Mesonotum and metanotum and first seven abdominal segments each with a medially interrupted transverse dark band, and a narrow dark band on the sutures between the thoracic and abdominal segments. Caudal fork subequal in length to abdomen, the two processes inwardly curved; color dark brown to deep black toward apex, the surface minutely toothed. Abdominal sternites II to VII transversely banded with dark brown to black; band broadly interrupted with yellow on sternites II, III, and VII. Coxal region and outer margins of legs dark marked. Head pale yellow, area around ocelli dark; labrum and mandibles dark.

Pupa (fig. 8).—Length 11 mm. Upper surface pale yellow except as follows: pronotum with two longitudinal dark marks near middle, a small rounded spot laterad of this, and a transverse band arising near lateral margin and extending mesad; extreme anterior margin dark on either side of apex, and two small dark tubercles or swellings on margin about midway to base. Mesonotum and metanotum each with a median and a lateral dark spot. First five abdominal segments with lateral pointed processes, pale in color except for dark apexes and dark anterior margins of processes of first segment. Processes generally directed forward. Abdomen with transverse dark markings.

Adult (figs. 1 and 2).—Length 12 to 15 mm.; width 7.5 to 11 mm. Color yellowish green to grey. Pronotum with three primary dark areas: a small median dark spot slightly behind middle, and on each side an irregular trilobed spot at base about midway between meson and lateral pronotal margin. Anterior to the median and lateral spots is a shallow U-shaped dark area consisting of many small irregular dots. Elytra rather prominently raised or tumid in basal third. Posterior two-thirds of elytra, behind apex of tumidity, with several small dark spots near suture. Longitudinal impression near lateral margin of elytron occasionally with a few dark punctures. Metasternum on each side of meson suddenly declivous laterally and posteriorly so as to become conspicuously angulate. Legs largely yellow with nearly all of posterior margins of femora and tibiae dark; femur with an irregular dark area on each side extending from dark marginal area. Prosternum and mesosternum mostly yellow; metasternum and abdomen with extensive dark areas, the metasternum lighter on sides and anteriorly. Abdomen with median and a lateral dark area as in fig. 1. Spermatheca of female genitalia (figs. 16, 16A, 16B) with a strong constriction before opening to gland; a distinct swelling beyond constriction leading to a relatively short and convoluted spermathecal duct; duct about as long and approximately of same width as shown for *unipunctata* (fig. 13A). Illustrations show variation in spermatheca of females from Monterey, Mexico, and Mercedes, Texas. Apical region of male genitalia in dorsal view (fig. 10) rather suddenly narrowed and emarginate before apex; aedeagus process (fig. 10A) arrowhead shaped but with a long, wide, slightly flaring basal shaft; process nearly straight in lateral view.

This species is unique in our fauna in the type of pronotal maculation,

ventral coloration, and the usually tumid elytra. Of the North American species, its larva is more closely related to *unipunctata* by having three lateral spines on the prothorax, and two each on the mesothorax and metathorax.

Records.—Mercedes and Brownsville, Texas. Larvae, April, May, August; pupae, May; adults, May and July.

Host.—*Cordia boissieri.*

UNRECOGNIZED SPECIES

Physonota pacifica Spaeth (1932, p. 198)

This species, described from one specimen from California, E. Donge, 1910, has not been recognized in the material available for study. It was compared with *alutacea* Boh.

Physonota picticollis Boheman (1854, p. 193)

Described originally from Mexico, this species has been recorded as occurring in Arizona. Barber (1916) compared an Arizona example, identified by Schaeffer as *picticollis*, with a Guatemalan specimen of *picticollis* from the Biologia material, stating that they differed in habitus. Subsequently Schaeffer described *P. unipunctata arizonense*, apparently considering that his Arizona species was undescribed.

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POSTSCRIPT ON THE "ODD BEETLE"

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Ignotus is a synonym of *Thylodrias.*

In a much appreciated note from A. N. Zhelokhovtsev of the Zoological Museum, Moscow State University, in reply to my recent notes on this pest[1] the original type, a male, of *Thylodrias contractus* Mots., 1839, is said to display nine-jointed antennae conforming fully with my illustration (p. 346, fig. 1A). The antennae are not eleven-jointed as described by Motschulsky and shown in his illustration which was photographically copied as my figure 1C. Other morphological characters of the type coincide with the description by A. P. Semenov, 1912, in the Russian Entomological Review, vol. 12, p. 498. Such errors by old authors may be numerous. Reliance on record of detail may greatly mislead us. Our modern lenses and better standard of preservation of specimens show us structures which were misunderstood by our predecessors with their poor optical equipment and inadequate samples, but our present standards and methods will probably be considered inadequate by our successors.

The synonymy which I indicated at the bottom of page 347 is therefore to be accepted and the alternative synonymy suggested at the top of page 348 rejected. Occurrence of this pest in Montreal has been added to the record by Robert.[2] I should have emphasized the fact that infestations by this species are usually evident from their numerous larval skins. These skins differ greatly from larval exuviae of other small dermestids by showing a single transverse row of almost contiguous curved stiff hairs across each tergite. Even where the species is abundant one rarely finds adults of either sex.

[1]Barber, H. S., 1947, Ann. Ent. Soc. Amer., 40: 344–349.

[2]Robert, A., 1947, Nat. Canad., 74: 189–194.

A NEW SPECIES OF MITE, HYPOASPIS MURINUS, FREQUENTLY TAKEN FROM RATTUS SPP.
(Laelaptidae: Hypoaspinae)

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AND

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The species of mite here described has been recovered regularly enough in various rat ectoparasite surveys that it has become necessary to have a name for it. We have not been able to find a suitable description in the available literature and are forced to conclude that it is new. It is described below as follows.

Hypoaspis murinus n. sp.

Female.—Pale brownish in color, oval in outline and with faint shoulders; average size about 580 μ long by 360 μ wide. The setae are of moderate length and thickness. The measurements given below are in microns and indicate the average and the two extremes of 10 measurements.

	D L	D W	StL	StW	GVL	GVW	A L	A W	A-GV	F Lg	H Lg	T I
Smallest.....	533	347	111	87	183	112	73	73	20	413	447	12.0
Average.....	581	359	115	93	211	119	86	84	37	465	481	12.5
Largest.....	666	378	125	99	216	133	93	93	80	507	520	13.6

The above symbols are explained as follows: D L, Length of the dorsal plate: D W, Width of the dorsal plate; StL, Length of the sternal plate; StW, Width of the sternal plate at its narrowest point; GVL, Length of the genitoventral plate, measured from the posterior margin of the sternal plate to the tip of the genitoventral plate; GVW, Width of the genitoventral plate at the widest point; A L, Length of the anal plate from the anterior margin to the base of the odd seta; A W, Width of the anal plate; A-GV, Distance between the genitoventral and anal plates; F-Lg, Length of leg I from base of coxa to tip of tarsus exclusive of the claw; H-Lg, Length of leg IV similarly measured; T I, Length of tarsus I, exclusive of the claw.

Venter.—Sternal plate reticulate, longer than wide, the posterior margins extending to the middle of coxa III; with three pairs of setae and two pairs of pores. Presternal area lightly sclerotized and containing a distinct pair of transversely bistriate presternal plates (fig. B). Endopodal plates quite distinct and extending from the posterior lateral angle of the sternal plate to the posterior edge of coxa IV; endopodal seta slightly more slender than the sternal setae. Genitoventral plate drop-shaped, noticeably broadened behind coxa IV, and bearing one pair of setae; posteriorly it extends fairly close to the anal plate (average distance 37 μ); configuration of lines apparently characteristic and essentially as shown in fig. B. Anal plate roundly triangular, the anterior margin strongly arched, the anal pore placed nearer the posterior

than the anterior margin; the three anal setae of equal size, the paired ones placed opposite the middle of the anal pore. A pair of large, roughly elliptical metapodal plates and three pairs of small ones, placed as shown in fig. B. Setae on the non-sclerotized portion of the venter varying in number from 7–10 pairs; the number frequently different on opposite sides of the same individual. Stigma situated opposite the posterior edge of coxa III, the narrow peritreme extending forward to the middle of coxa I. Post-stigmatal sclerotization reaching backward to a point opposite the middle of coxa IV where it is truncate and bears a pore. Tritosternum branching at the apex of the basal segment. Cilia extending from base to apex of each segment, rather long and widely spaced.

Dorsum.—Dorsal plate undivided and normally covering the entire dorsum, but occasional mounts showing a narrow uncovered portion (note dotted line in fig. B); about 36 pairs of setae placed in a definite pattern anteriorly but tending to be irregularly scattered posteriorly. Setae moderately long, rather weak and only barely overlapping each other; subequal throughout, the penultimate pair as long as the last pair,differing in this respect from the laelaptines, in which the penultimate is always shorter. About 10 pairs of pores scattered over the dorsum, including a pair of large slit-like pores at the anterior end (fig. A). A network of fine lines visible over the entire plate. Posterior pair of setae appearing weakly plumose.

Gnathasome (figs. A, C and D).—Corniculi pronounced and strongly pigmented. Lingula (labium) acutely triangular. Hypostome with six rows of minute denticles, each row consisting of approximately 10 teeth. Epistome rather short, convex and with serrated margin (fig. A). Chelicerae prominent (figs. C and D being drawn to the same scale), with the arms of the chela subequal. Digitus mobilis with two teeth well below the incurved apex and with a semi-circle of small setae at its base; digitus fixus with four teeth and a slender, straight, non-inflated pilus dentilis.

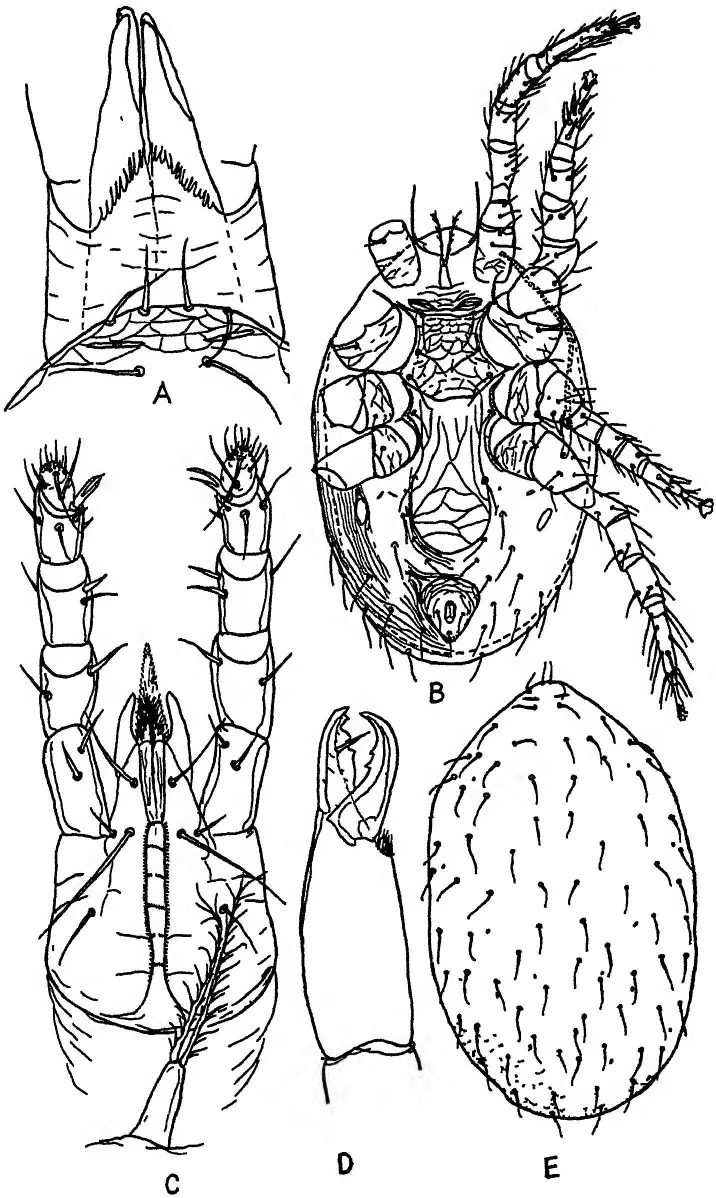
Legs.—Setation as shown in fig. B. Coxae I–III each with two slender setae, coxa IV with one. No spurs or heavy spines, but the apical setae of tarsi II–IV, especially of tarsus II, quite strong; dorsal setae slender and of uniform lengths throughout. All tarsi with claws and pulvillus.

Male.—not known.

Immature forms.—not known.

Types.—described from 35 females of which one was designated holotype and the rest paratypes. The holotype was taken from *Rattus norvegicus*, April 11, 1945, Galveston, Texas, and is deposited in the U. S. National Museum. Paratypes are in the collections of the University of Texas Medical School, the Texas State Health Department, and in the U. S. National Museum.

Hosts and distribution.—CALIFORNIA: Litter from chicken house, Santa Clara County, April, 1937, 3 specimens. FLORIDA: *Rattus norvegicus* (Erxleben), Jacksonville, November, 1947, (M. L. Braswell, collector) 3 specimens. GEORGIA: *Rattus rattus alexandrinus* (Geoffroy), Richmond County, February 8, 1946, 1 female. *Rattus norvegicus* (Erxleben), Colquitt County, March 26, 1946, 1 female. *Field mouse,*



Hypoaspis murinus, female. A. Epistome and anterior portion of dorsum. B. Venter. C. Gnathasome and tritosternum, ventral view. D. Chelicera. E. Dorsal plate.

species undetermined, Grady County, December 27, 1946, 3 slides, 8 specimens. *Rattus norvegicus* (Erxleben), Decatur County, January 3, 1947, 1 female. *Sigmodon h. hispidus* (Say & Ord), Grady County, April 15, 1947, 1 slide, 2 females. *Rattus norvegicus* (Erxleben), Decatur County, June 6, 1947, 1 female. *Rattus norvegicus* (Erxleben), Thomas County, July 10, 1947. 1 female. *Rattus norvegicus* (Erxleben), Thomas County, October 2, 1947, 1 female. *Rattus norvegicus* (Erxleben), Decatur County, October 7, 1947, 1 female. *Rattus rattus alexandrinus* (Geoffroy), Grady County, October 23, 1947, 1 female. *Rattus rattus rattus* (Linnaeus), Grady County, December 12, 1947, 1 female. MASSACHUSETTS: Water chestnut, Boston, from China, September ,1934, 1 female (O. A. Hardy, collector). NEW YORK: Banana debris, New York, from Panama, 1936 (P. Ortiz, collector). Hyacinth bulbs, New York, from Holland, April 2, 1946 (J. Cochran, collector). TEXAS: *Rattus norvegicus*, Galveston County, April 11, 1945, 2 specimens. *Rattus norvegicus*, Sàn Antonio, Bexar County, May 1, 1947 (Mason, collector). *Rattus alexandrinus*, Lavaca County, April 4, 1947 (Barns, collector). VERMONT: *Peromyscus maniculatus gracilis*, Morgan, Vermont, September 4, 1932, 4 specimens, 1 slide (Francis Harper, collector).

Remarks.—At first glance, this mite appears similar to *Atricholaelaps*, but a critical study soon reveals many differentiating features. In this mite, the sternal plate is longer than wide, there are two distinct jugular plates, the tritosternum branches at the apex of the basal portion, the teeth on the hypostome are 8–10 or more per row (3–5 in *Atricholaelaps*) the epistome is serrated and the pilus dentilis is not inflated.

The genus *Hypoaspis* is still poorly understood; we are using it here in the sense that Vitzthun uses it in his 1941 classification.

This species differs from other *Hypoaspis* with which we are familiar in having a somewhat longer sternal plate, heavier spines on tarsus II, fewer teeth on the chelae, and noticeably shorter dorsal setae.

It is true that this mite is recovered fairly frequently from rats, yet it is never abundant and whether it is truly parasitic is questionable.

Acknowledgements.—We wish to express our sincere appreciation to personnel of the U. S. Public Health Service for making these slides available to us and permitting us to publish the description. Especially do we appreciate the cooperation of Harvey B. Morlan, S. A. Sanitarian (R) who supplied us with all the Georgia records, and D. C. Thurman, Jr., S. A. Sanitarian (R) for the Florida records. Also we wish to thank Edw. W. Baker for material from the U. S. National Museum and Louis J. Ogden, S. A. Sanitarian, and Ernest Watson for access to material from the typhus survey in Texas.

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ON SOME AMERICAN SPIDERS OF THE FAMILY ERIGONIDAE[1]

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The present paper is necessitated by the large number of new forms that came to light while the writer was undertaking to arrange systematically the extensive collection of Erigonidae accumulated over many years at the University of Utah. To diagnose and name a portion of these new forms at this time seems a desirable step in work on the taxonomic problem presented by this large and difficult family, even though the assignment of some species to their genera must for the present be tentative, more especially where the species are known only from females. This must remain the situation until much work is done by way of establishing or clarifying the too much neglected generic characters presented by the females and of correlating these with those of the males.

The writer is glad to acknowledge here the assistance given by Mr. Wilton Ivie, his former associate at the University of Utah, in the preparation of many of the descriptions and drawings reproduced in this paper.

Genus **Anacornia** Chamberlin and Ivie, 1933

Bull. Univ. Utah, Biol. Ser., 2(2): 29.

Orthotype: *Anacornia microps* Chamberlin and Ivie.

Anacornia microps Chamberlin and Ivie

Figs 1–3

Anacornia microps Chamberlin and Ivie, 1933, Bull. Univ. Utah, Biol. Ser., 2(2): 29; *6: 58–60 and 7: 63–68.

Additional figures of this species are given to facilitate comparison with the next species.

Anacornia proceps new species

Figs. 4, 5

Carapace light brownish yellow. Chelicerae orange brown. Sternum and labium yellowish, lightly shaded with dusky. Endites yellowish to orange. Legs and palpi light yellowish brown. Abdomen light to medium gray. Spinnerets yellowish. Epigynum and male palpus reddish brown.

Head of male elevated forward and projecting over clypeus; a short, blunt horn, bearing numerous short setae, projecting forward from median ocular area. Eye area with many short setae. Eyes small, widely separated; anterior row recurved, a. m. eyes subcontiguous, about three diameters from lateral eyes. Posterior row slightly

[1]Cost of publication paid in part by the Research Committee, University of Utah.

recurved; p. m. eyes about 4 diameters apart, a little more than 2 diameters from the side eyes. Median ocular quadrangle wider behind than long; more than twice as wide behind as in front. Height of clypeus about 5 diameters of a. m. eyes. Chelicerae normal; stridulating file weak; fang groove with five teeth in front, (three or) four behind. Legs normal, sternum pointed behind, separating hind coxae by one diameter or less.

Palpus: Femur and patella normal. Patella a little longer than wide; convex on ventral side; excavated ectally on dorsal side, with a keel-like, two pointed spur on meso-posterior side of depression. Thick patch of long setae on ectal side, their cymbium normal. Paracymbium hooked. Subtigulum and tigulum normal with broad, short bizel. Embolic division with central part bullous with a distal lamella supported by a dark, pointed process; with a flattened, clavate tail-piece; embolus long and looped with a slender lash-like tip, and a pointed process attached at base.

Female.—Head not elevated nor extended forward. Inter-ocular area without numerous short setae. Anterior eye row slightly recurved; a. m. eyes subcontiguous, about 2 diameters from side eyes. Posterior row straight; p. m. eyes about 3 diameters apart, about 2 diameters from side eyes. Median ocular quadrangle wider than long, much wider behind than in front. Epigynum transverse, short (figs. 4, 5).

Measurements:

	♂		♀	
	Mm.	*Ratio*	*Mm.*	*Ratio*
Length	2.15	195	2.70	216
Carapace:				
Length	1.10	100	1.25	100
Width	0.80	73	0.86	69
Tibia-patella:				
1	1.06	96	1.12	90
4	1.12	102	1.27	102

Type locality.—UTAH: vicinity of Mirror Lake, Uintah Mts., Sept. 22, 1932, ♂ holotype, ♀ allotype; July 28, 1936, 3 ♂ paratypes; W. Ivie collector.

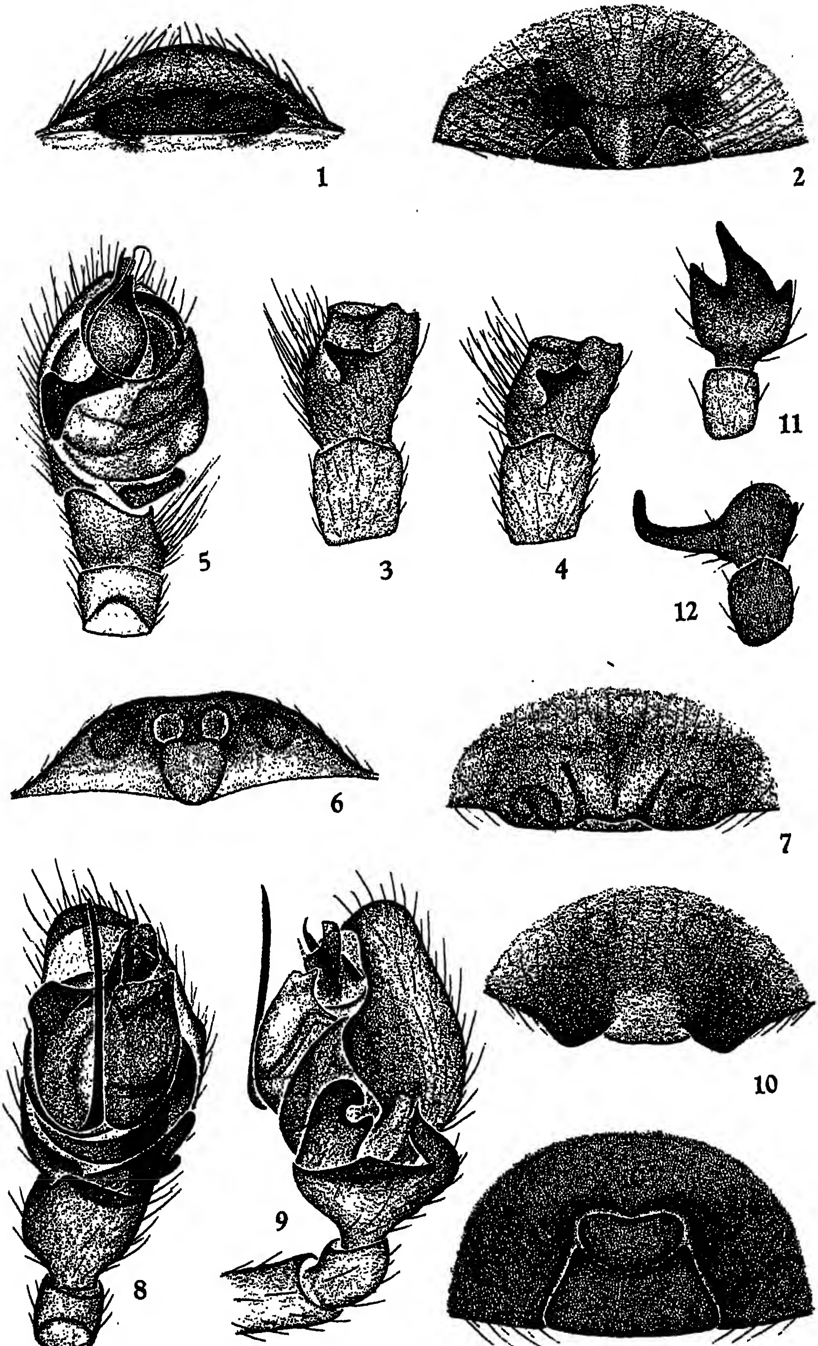
Other records.—UTAH: Provo River at Cobble Rest Camp, Uintah Mts., July 30, 1936, 2 ♂, 2 ♀, W. Ivie; Chalk Cr., Uintah Mts., Aug., 1929, ♂, R. V. Chamberlin.

Genus **Catabrithorax** Chamberlin, 1920

Orthotype: *Catabrithorax clypiellus* Chamberlin.

EXPLANATION OF PLATE I

1. *Anacornia microps* Chamberlin and Ivie. Epigynum, caudal view. 2. *Anacornia microps*, n. sp. Epigynum, ventral view. 3. *Anacornia microps* Chamberlin and Ivie. Patella and tibia of ♂ palpus, dorsal view. 4. *Anacornia proceps* n. sp. Patella and tibia of ♂ palpus, dorsal view. 5. *Anacornia proceps* n. sp. ♂ palpus, meso-ventral view. 6. *Catabrithorax* (*Stenosus*) *plumosus* (Emerton). Epigynum, caudal view. 7. *Catabrithorax* (*Stenosus*) *plumosus* (Emerton). Epigynum, ventral view. 8. *Catabrithorax stylifer* n. sp. ♂ palpus, subventral view. 9. *Catabrithorax stylifer* n. sp. ♂ palpus, ectal view. 10. *Catabrithorax stylifer* n. sp. Epigynum. 11. *Catabrithorax stylifer* n. sp. Patella and tibia of ♂ palpus, dorsal view. 12. *Ceraticelus tuganus* n. sp. Patella and tibia of ♂ palpus. 13. *Ceraticelus tuganus* n. sp. Epigynum.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Subgenus **Catabrithorax**, sens. str.

Catabrithorax (Catabrithorax) clypiellus Chamberlain

Catabrithorax clypiellus Chamberlin, 1920, Canadian Ent., 52: 199; *1–3.
Catabrithorax ceuthus Chamberlin, 1920, Canadian Ent., 52: 200; *4–5.
Catabrithorax clypiellus Crosby & Bishop, 1928, New York State Mus. Bull. no. 278: 64; *78–80.

Type locality.—UTAH: Logan Canyon, ♂ holotype. (Chamberlin, 1920.) M. C. Z.

Other records.—COLORADO: Berthoud Pass, Aug. 24, 1935, 4 ♂, 4 ♀. IDAHO: Pineview, Aug. 14, 1940, ♂. UTAH: Mirror Lake, Uintah Mts., Aug. 18, 1942, ♂♂, ♀♀, W. Ivie; Fish Lake; Sept. 4, 1929, ♂ ♀, Chamberlin and Gertsch. WYOMING: Bridge Bay, Yellowstone Lake, Aug. 11, 1940, 3♂, 5♀.

Catabrithorax (Catabrithorax) stylifer, new species

Figs. 8–11

Catabrithorax clypiellus Chamberlin and Ivie, 1933, Bull. Univ. Utah. (Not *C. clypiellus* Chamberlin, 1920).
Catabrithorax clypiellus Chamberlin and Ivie, 1947, Bull. Univ. Utah, 10(3): 30.

Male, female.—Color: Carapace light brown, lightly shaded and marked with dusky. Chelicerae and endites light orange brown. Sternum and labium dusky brown. Legs and palpi yellowish brown. Abdomen dark gray. Spinnerets yellowish brown.

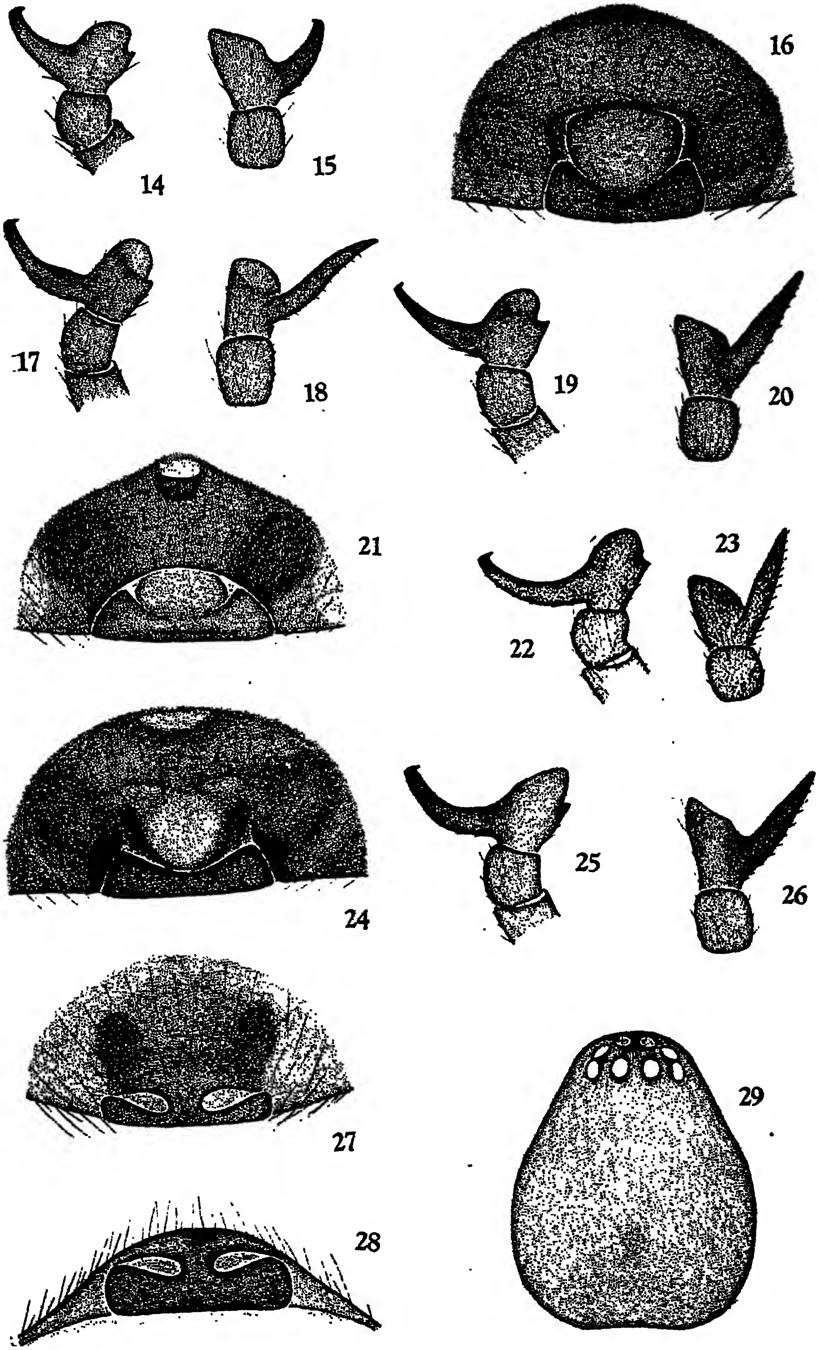
Structure: Essentially normal. Head of male very slightly humped back of the eyes. Height of clypeus 2.5 diameters of an a. m. eye in female, 3.0 diameters in male. Anterior eye row straight; a. m. eyes about 0.3 diameter apart, about the same distance from the larger side eyes. Posterior row straight; eyes equidistant, 0.8 or 0.9 diameter apart. Median ocular quadrangle a little longer than wide, slightly wider behind than in front. Chelicerae vertical, normal; stridulating file present in both sexes; fang groove with five teeth in front, four tiny denticles behind. Structure of the epigynum and palpus shown in the figures.

Measurements:

	♂ *Mm.*	♂ *Ratio*	♀ *Mm.*	♀ *Ratio*
Length	1.73	211	1.82	212
Carapace:				
Length	0.82	100	0.86	100
Width	0.64	78	0.64	74
Tibia-patella:				
1	0.64	78	0.70	81
4	0.73	89	0.82	95

EXPLANATION OF PLATE II

14, 15. *Ceratinella brunnea* Emerton. Patella and tibia of ♂ palpus, two views. 16. *Ceratinella buna*, n. sp. Epigynum. 17, 18. *Ceratinella buna* n. sp. Patella and tibia of ♂ palpus, two views. 19, 20. *Ceratinella diversa* n. sp. Patella and tibia of ♂ palpus, two views. 21. *Ceratinella ornatula alaskana* n. sp. Patella and tibia of ♂ palpus, two views. 22, 23. *Ceratinella placida* Banks. Patella and tibia of ♂ palpus, two views. 24. *Ceratinella tigana* n. sp. Epigynum. 25, 26. *Ceratinella timpibius* n. sp. Patella and tibia of ♂ palpus, two views. 27, 28. *Ceratinops uintana* n. sp. Epigynum, ventral and caudal views. 29. *Ceratinopsis gosibia* n. sp. Cephalothorax, dorsal view.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Type locality.—UTAH: South Fork of Raft River, 8 miles south of Lynn, Sept. 6, 1932, ♂ holotype, ♀ allotype, ♂♂ ♀♀ paratypes (Chamberlin and Ivie); Dove Creek and Clear Creek, 1933, ♂♂ ♀♀ (Chamberlin and Ivie).

Other records.—ALASKA: Homer, July 20–25, 1945, ♀, J. C. Chamberlin. CALIFORNIA: Eureka, July 13, 1937, 4 ♂, 3 ♀, R. V. Chamberlin; Weed, Sept. 7, 1935, ♂, 4♀, Chamberlin and Ivie; Mt. Lassen Park, Sept. 7, 1935, ♂♂ ♀♀, Chamberlin and Ivie; E. side Mammoth Lake, Aug. 9, 1931, ♀, W. Ivie. IDAHO: Lost Lake, Aug. 20, 1936, ♂, 2 ♀, W. Ivie; Lake Forks, July 4, 1943, 3 ♀, W. Ivie. NEVADA: Ruby Valley, Sept., 1937, 3 ♀, R. V. Chamberlin. OREGON: Hillsboro, 1937, ♀, J. C. Chamberlin; Three Rocks, near Otis, May 31, 1942, ♀, J. C. Chamberlin; Newport to Waldport, April 25, 1937, ♂, J. C. Chamberlin; Hauser, May 26, 1937, 2 ♂, ♀♀, J. C. Chamberlin.

This species is very close to *C. clypiellus* Chamberlin, but is disdinguishable mainly by the more slender extension from the tail-piece of the embolic division.

Subgenus **Catosus**, new

Orthotype: *Catabrithorax oxypaederotipus* (Crosby).

In the male this subgenus is distinguished by the branched tail-piece of the embolus of the palpus.

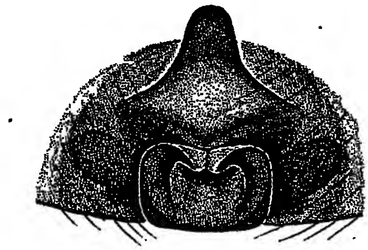
Catabrithorax (Catosus) oxypaederotipus (Crosby)

Oedothorax oxypaederotipus Crosby, 1905, Proc. Acad. Nat. Sci. Phila., 336; *28.9, 15.
Oedothorax oxypaederotipus Petrunkevitch, 1911, Cat. Spid. Amer., 264.
Tmeticus aestivalis Emerton, 1911, Trans. Conn. Acad. Sci., 16: 394; *3: 1–1c.
Tmeticus aestibalis = *Oedothorax oxypaederotipus* Barrows, 1924, Ohio Journ. Sci., 24: 312.
Catabrithorax oxypaederotipus Crosby & Bishop, 1928, N. Y. State Mus. Bull., no. 278: 66; *91–93.

Records.—MASSACHUSETTS: Holden, June, ♂ ♀, (Emerton, 1911, cotypes of *Tmeticus aestivalis* Emerton); Mt. Toby, June, ♂ ♀, (Emerton, 1911; cotypes of *T. aestivalis*). NEW YORK: Old Forge, Oct. 24, 1922, ♀, C. R. Crosby (Cr. & Bishop, 1928); Meredith, May 19, 1923, 5 ♂ ♀, (Crosby & Bishop, 1928); Slide Mt., May 8, 1921, 2 ♂, 5 ♀, (Crosby & Bishop, 1928); Paradise, Orange Co., May 26, 1920, ♀, (Crosby & Bishop, 1928); Oakland Valley, May 26, 1920, ♂, ♀ (Crosby & Bishop, 1928); Belden Hill, Broome Co., May 19, 1923, ♂♂, ♀♀' (Crosby & Bishop, 1928); Ithaca, February-July, ♂♂, ♀♀, (Crosby, 1905 types), various dates (Crosby & Bishop, 1928); "Cuyahoga," Yakes Co., June 24, 1923, 14 ♀, (Crosby & Bishop, 1928); Letchworth Park, Wyoming Co., July 9, 1922, ♂, 2 ♀, (Crosby & Bishop, 1928);

EXPLANATION OF PLATE III

30. *Ceratinopsis gosibia* n. sp. Epigynum. 31. *Ceratinopsis gosibia* n. sp. Patella and tibia of ♂ palpus. 32. *Ceratinopsis gosibia* n. sp. Embolus of ♂ palpus, ventral view. 33. *Ceratinopsis watsinga* n. sp. Epigynum. 34. *Ceratinopsis interventa* n. sp. Epigynum. 35. *Ceratinopsis secuta* n. sp. Epigynum. 36. *Ceratinopsis eutypa* n. sp. Epigynum. 37. *Ceratinopsis (?) oregonicola* n. sp. Epigynum. 38. *Ceratinopsis crosbyi* n. sp. Epigynum. 39. *Ceratinopsis palomara* n. sp. Epigynum, ventral view. 40. *Ceratinopsis palomara* n. sp. Epigynum, caudal view.



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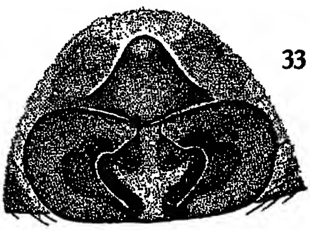

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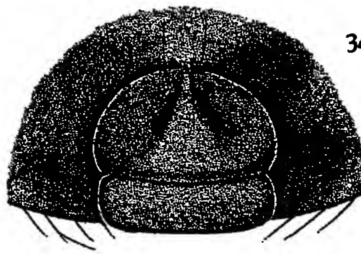

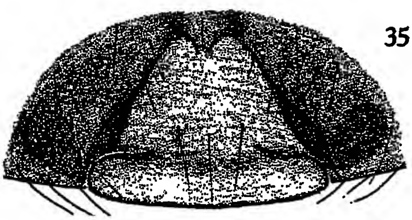

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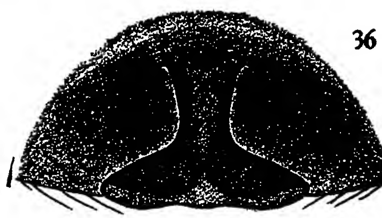

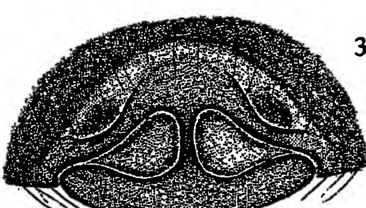

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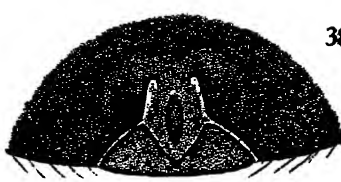

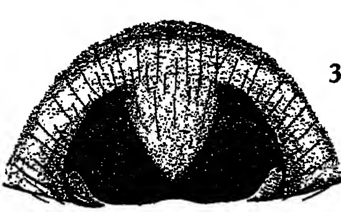

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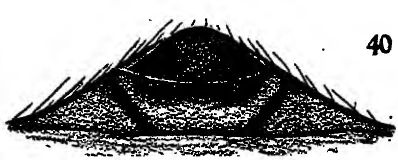


Little Valley, etc., 1925, 3 ♀, (Crosby & Bishop, 1928); Penn Yan, May 30, 1923, 14 ♂, (Crosby & Bishop, 1928), etc. OHIO: Rockbridge, May 4, 1918, ♂, W. M. Barrows (Barrows, 1924); Flint, April 28, 1918, ♂, W. M. Barrows (Barrows, 1924). PENNSYLVANIA: President, July 3, 1922, ♀, Palmer (Crosby & Bishop, 1928); Potters Mills, October 31, 1924, ♀, (Crosby and Bishop, 1928).

Subgenus **Stenosus** new

Orthotype: *Stenosus plumosus* (Emerton).

In this subgenus the tail-piece of the ambolus of the male palpus is simple and hairy or plumose instead of bearing spines or scales as in *perplexus*, etc.

Catabrithorax (Stenosus) plumosus (Emerton)

Figs. 6, 7

Tmeticus plumosus Emerton, 1882, Trans. Conn. Acad. Sci., 6: 53; *15: 3.
Tmeticus obscurus Banks, 1892, Proc. Acad. Nat. Sci. Phila., 38; *4: 14, 14a.
Tmeticus humilis Banks, 1892, Ibid. 38; *4: 18.
Gongylidium plumosus Simon, 1884, Arachnides de France, 5: 500.
Oedothorax plumosus Crosby, 1905, Proc. Acad. Sci., Phila., 312.
Oedothorax plumosus Petrunkevitch, 1911, Cat. Spid. Amer., 265.
Oedothorax humilis Petrunkevitch, 1911, Ibid., 262.
Oedothorax obscurus Petrunkevitch, 1911, Ibid., 264.
Tmeticus (Gonglydium) plumosus Banks, 1916, Proc. Acad. Sci. Phila., 74.
Gongylidium plumosus Emerton, 1920, Trans. Royal Can. Inst., 12: 316.
Gongylidium plumosus Emerton, 1924.
Tmeticus plumosus Barrows, 1924.
Catabrithorax plumosus Crosby & Bishop, 1928, N. Y. State Mus. Bull., no. 278; 70; *97–101 (not 100).
Oedothorax plumosus Kurata, 1937, Canadian Field-Nat., 51: 114.

Type localities.—CANADA: Montreal. MASSACHUSETTS: Beverly. NEW HAMPSHIRE: Mt. Washington.

Other records.—CONNECTICUT: Mantic, May 15, 1921, ♂, J. H. Emerton, (Crosby & Bishop, 1928); Norwalk, July 2, 1933, ♀, Wilton Ivie. IDAHO: Mesa, July 2, 1943, ♀, W. Ivie. ILLINOIS: Willow Springs, July 1, 1941, ♀ Henry Dybas; Salts, Aug. 26, 1926, ♂, Smith, (Crosby & Bishop, 1928). MASSACHUSETTS: Beverly, ♀♀, (Emerton, 1882, cotypes); Winthrop Beach, Nov. 12, 1922, 3 ♂, ♀, (Crosby & Bishop, 1928); Cambridge, Nov. 17, 1922, ♂, (Crosby & Bishop, 1928); Duxbury, June 4, 1921, ♂, E. B. Bryant, (Crosby & Bishop, 1928). MINNESOTA: Waskish, June 15, 1945, 2 ♀; 8 mi. S.E. Warren, June 12, 1945, ♂♂, ♀♀, W. Ivie. NEBRASKA: 10 mi. W. Grand Island, June 6, 1933, ♂, W. Ivie. NEW HAMPSHIRE: Mt. Washington, ♂♂, (Emerton, 1882, paratypes); Mt. Washington, Sept., 1907, ♂, E. B. Bryant, (Crosby & Bishop, 1928); Franconia, ♂, Nathan Banks, (Crosby & Bishop, 1928); Hollis, Aug. (M), 2 ♂, ♀, Wm. Fox, Aug. 4, 1911, E. B. Bryant, (Crosby & Bishop, 1928). NEW YORK: Kingston, March 12, 1919, ♂♂, ♀♀, C. R. Crosby, (Crosby & Bishop, 1928, Ms.); Constabeville, Aug. 19, 1927, ♂, P. Needham, (Crosby & Bishop, 1928); Inlet Marsh, Nov., 1888 or 1889, ♂, N. Banks, (Banks, 1892, holotype of *Tmeticus humilis* Banks); Six Mile Cr., 1888–1889, ♂, N. Banks, (Banks, 1892, holotype of *Tmeticus obscurus* Banks); Ithaca, March, 1910, March 17, 1912, July 17, 1920, 3 ♂, C. R. Crosby, (Crosby & Bishop, 1928). NOVA SCOTIA: Barrington, Summer, 1923, E. B. Bryant, (Em.,

1924). OHIO: Columbus, May 2, 1918, ♂, W. M. Barrows, (Barrows, 1924). ONTARIO: Mer Bleue, 10 mi. E. Ottawa, June 2–3, 1931, T. B. Kurata (Kurata, 1937); Algonquin Park, June-July, 1945, ♂, 2 ♂, T. B. Kurata; Port Credit, June 23, 1945, ♀, Stanley Harrod. OREGON: 2 mi. No. Ashland, Sept. 9, 1935, ♂, Chamberlin & Ivie. QUEBEC: Montreal, ♂♂, (Emerton, 1882, cotypes); Lake Megantic, (Emerton, 1920). UTAH: Moab, June 19, 1934, ♂, 3 ♀, W. Ivie & H. A. Rasmussen; Price, June 16, 1940, 4 ♀; Fish Lake, Aug., 1934, ♂. WYOMING: 20 Mi. So. Jackson, June 24, 1938, ♂♂ ♀♀.

Genus **Ceraticelus** Simon, 1884

Arachnides de France, 5: 595.

Generotype: *Ceraticelus fissiceps* (Cambridge).

Ceraticelus agathus, new species

Fig. 157

Female.—Color: Carapace light brown, with eye area black, and with a diffused dusky median line extending back to the median furrow. Chelicerae and endites orange. Sternum and labium yellowish shaded with dusky. Legs and palpi light yellowish brown, with the hind tibia a little darker than the rest. Abdomen light yellowish gray, with sclerites bright orange brown. Spinnerets light brown, surrounded with a light dusky shading.

Structure: Carapace essentially normal, median groove obscure. Clypeus nearly vertical; about 2.5 diam. of a. s. eye in height. Eyes moderately large; the a. m. eyes much smaller than the others. Eye area occupying nearly the full width of the head. Anterior eye row slightly procurved; a. m. eyes 0.9 diameter apart, 1.0 diameter from side eyes. Posterior row faintly recurved; p. m. eyes 0.7 diameter apart, same distance from the slightly smaller side eyes. Median ocular quadrangle about as wide as long, wider behind than in front. Chelicerae normal. Sternum large; broad hind tip separating hind coxae by a length. Legs and palpi normal. Abdomen rounded; with an oval dorsal sclerite which is half the width and two-thirds the length of the abdomen; with a lunate sclerite below and largely surrounding the spinnerets; with a sclerite surrounding the petiole and extending back to include the epigynum, and with lateral epigastric sclerites, separated from the last by a narrow line.

Measurements:

	♀ Holotype *Mm.*	*Ratio*
Length	1.30	236
Carapace:		
Length	0.55	100
Width	0.44	80
Tibia-patella:		
1	0.40	73
4	0.44	80

Ceraticelus subniger, new species

Figs. 44, 45

Color: Carapace slightly dusky over a background of light brown, with a network of black lines in front of the median stria with three lines

running forward on the head. Chelicerae and endites yellow. Labium yellow with a black cross mark. Sternum dusky or nearly black. The legs light yellow, with the coxae having a black line across distal end and some a longitudinal ventral line. Abdomen blackish throughout excepting the area immediately surrounding the epigynum and the corresponding part of the male.

Structure: The cephalothorax normal, the head in the male moderately roundly elevated behind the eye area. Clypeus about four times the diameter of an a. s. eye. Posterior row of eyes procurved, the median eyes considerably farther from the side eyes than from each other. Anterior row of eyes slightly procurved; the median eyes small about their radius apart but widely separated from the laterals. Quadrangle of median eyes decidedly wider behind than in front. Fang groove of chelicera with five teeth on anterior margin and one on posterior.

The epigynum is of the same general type as that of *formosus* as shown in fig. 44. The apophysis of the male palpus is as shown in fig. 45.

Type locality.—UTAH: 10 miles W. of Salt Lake City; ♂ holotype and ♀ allotype taken Oct. 14, 1939.

Superficially distinguishable from *formosus* in the black color of the dorsal abdominal sclerite of the male.

Ceraticelus formosus pistus, new species

Fig. 46

Close in coloration and general structure to *formosus* but presenting minor but apparently distinct differences, especially in the epigynum and the male palpus. In the epigynum the median area flares out more strongly caudad, with other features as shown in fig. 46. The tibial apophysis of the male palpus as in *formosus* but distally less abrutply curved.

Type locality.—WYOMING: 4 mi. N. of "Old Faithful," Yellowstone Park; ♂ holotype and ♀ allotype taken June 17, 1938.

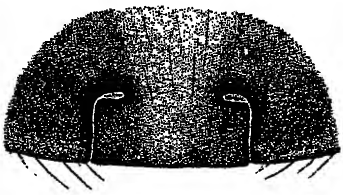
Ceraticelus laetabilis pisga, new subspecies

Fig. 47

Examination of a considerable number of specimens from Mt. Pisgah, North Carolina, shows certain obvious differences, especially in the epigynum, to be apparently constant. The characteristic form of the epigynum is as shown in fig. 44. See also Crosby & Bishop, Studies in New York Spiders, 1925, plate 5, fig. 51.

EXPLANATION OF PLATE IV

41. *Spirembolus oreinoides* n. sp. 42. *Disembolus zygethus* n. sp. 43. *Disembolus zygethus* n. sp. 44. *Ceraticelus subniger* n. sp. Epigynum. 45. *Ceraticelus subniger* n. sp. Patella and tibia of ♂ palpus, dorsomesal view. 46. *Ceraticelus formosus pistus* n. subsp. Epigynum. 47. *Ceraticelus laetabilis pisga* n. subsp. Epigynum. 48. *Coloncus siou* n. sp. Epigynum, ventral view. 49. *Coloncus siou* n. sp. Epigynum, caudal view. 50. *Coloncus ocala* n. sp. Epigynum, ventral view.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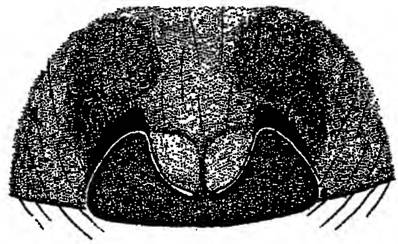
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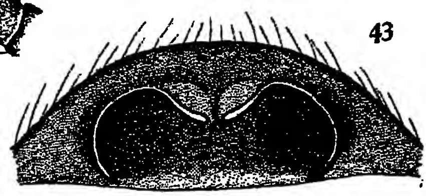
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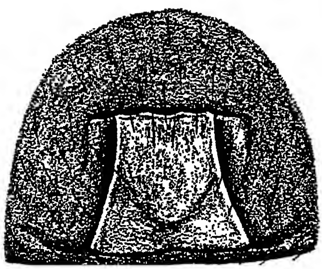
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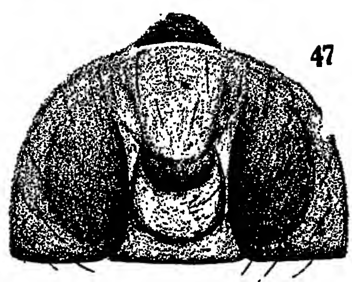
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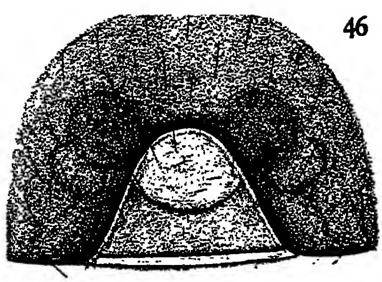
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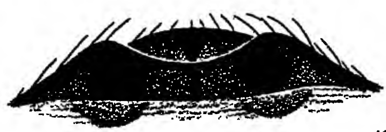
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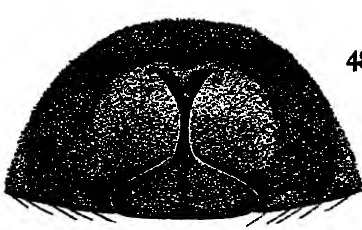
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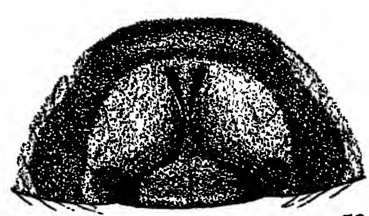
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All the typical specimens are lighter in color than most specimens of *lateobilis*, although this feature is subject to much variation.

Type locality.—NORTH CAROLINA: Mt. Pisgah, other data lacking; ♂♂ and ♀♀.

Ceraticelus tuganus, new species

Figs 12, 13

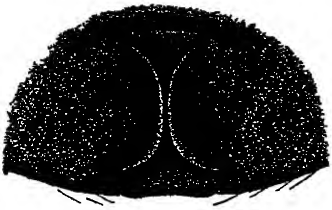
Male, female.—Color: Carapace dark brown, marked with dusky Chelicerae and endites brown, with lighter tips. Sternum and labium dark dusky brown. Legs and palpi brownish yellow, shaded at the joints; male palpus with tibia and tarsus dark brown Abdomen nearly black on the soft parts, with sclerites reddish brown shaded with dusky Spinnerets dusky brown. Epigynum mostly dark dusky brown.

Structure: Size medium. Male carapace broadly avoid, wide behind, narrow in front; clypeus slightly protruding; head slightly humped back of the eyes. Height of clypeus about 5 diameters of an a. s. eye Eye area occupies 0.7 to 0 8 width of head; eyes small Posterior eye row slightly procurved; p m. eye about 1.6 diameters apart, 2.0 diameters from side eye. Anterior row faintly procurved A. m eyes 0.8 diameter apart, 1.6 diameters from side eye. Median ocular quadrangle about as wide as long, a little wider behind Chelicerae vertical; fang groove with four teeth in front, three small teeth behind; stridulating file apparently absent Sternum as wide as long; intercoxal angles distinct, truncate behind, hind coxae separated by a little more than a diameter Abdomen somewhat elongate; dorsal sclerite rugose, with four large muscle impressions, equal to width at anterior end, covering anterior end and extending back for three-fourths of length. Epigastric plates distinct, area between sclerotized; a thin sclerite in front of spinnerets below. Palpus not significantly different from that of *rugosus*.

Female.—Carapace essentially normal; head larger than in male, slightly humped back of eyes. Clypeus slightly protruding; height 3.0 to 3 5 diameters of a. s eye. Eye area occupies 0.7 width of head Posterior eye row procurved; p. m eyes about 1 0 diameter apart, 1.2 diameters from side eye. Anterior row faintly procurved; a. m. eye about 0 5 diameter apart, 1 2 diameters from side eye. Median ocular quadrangle about as long as wide, wider behind. Chelicerae vertical without stridulating file (pick absent from palpus); fang groove with four large teeth in front, one or two small teeth behind Endites, labium and sternum normal; hind coxae separated by slightly more than a diameter. Palpi slender, small. Legs normal. Abdomen large, broadly oval, somewhat depressed; with rugose sclerite in front,

EXPLANATION OF PLATE V

51. *Coloncus americanus* (Chamberlin and Ivie). Epigynum. 52. *Coloncus pius* new species. 53 *Cornicularia selma* new species. Epigynum. 54 *Cochlembolus provo,* new species. Epigynum. 55. *Eularia selma* new species. Epigynum, ventral view.56. *Eularia selma* new species Epigynum, caudal view. 57. *Eularia quaestio* new species. Epigynum, ventral view. 58. *Eularia quaestio* new species. Epigynum, dorsal view 59. *Eularia kaiba* new species Epigynum, ventral view 60 *Eularia kaiba* new species Epigynum, caudal view



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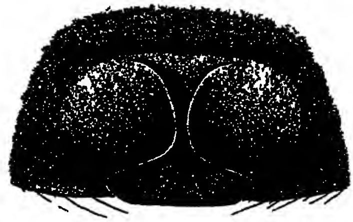

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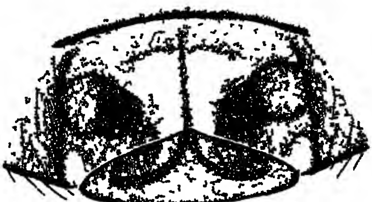

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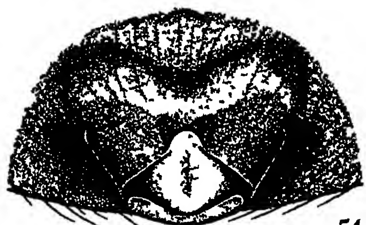

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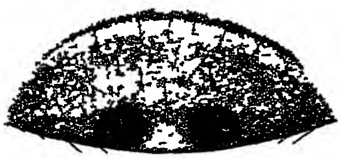

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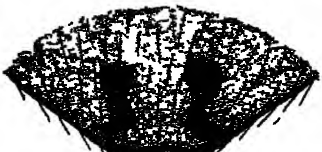

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60

four chitinous dots on top, and a small thin sclerite in front of the spinnerets. Epigynum small; consists of a depression which is wider behind than in front, quadrangular; contains a large transverse piece, concave across front; this is closely joined to a transverse, kidney-shaped middle lobe, which is distinctly separated from the anterior rim.

Measurements:

	♂ Mm.	♂ Ratio	♀ Mm.	♀ Ratio
Length	1.80	220	2.06	229
Carapace:				
Length	0.82	100	0.90	100
Width	0.70	85	0.75	83
Tibia-patella:				
1	0.66	80	0.72	80
4	0.72	88	0.81	90

Type locality.—UTAH: 10 mi. W. of Salt Lake City, October 14, 1939, ♂ ♀, same, May, 1938.

The male of this species is similar to *rugosus* but is darker in color with the dorsal sclerite more roughened and the embolus thicker at base.

The female more resembles *formosus;* but is darker in color and the epigynum is proportionately wider in front.

Genus **Ceratinella** Emerton, 1882

Trans. Conn. Acad. Sci., 6: 32.

Generotype: *Ceratinella breve* (Wider).

Ceratinella buna, new species

Figs. 16–18

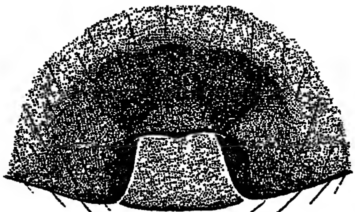
Male, female.—Color: Carapace dark brown; eyes on black spots. Chelicerae and endites light brown, lighter at distal end. Sternum and labium dusky brown, darker on the border. Legs and palpi light brownish orange, tibia and tarsus of male palpus darker brown. Abdomen with dorsal sclerite reddish brown, shaded around the border to a dark dusky at the edge, and with four dark spots near the center; sides and venter dark grey; ventral sclerites reddish brown. Spinnerets light brown. Epigynum reddish brown to dusky.

Structure: Size medium to small; typical for the genus.

Male.—Carapace short and wide, rounded; head short, not elevated. Clypeus slightly inclined; height about 2.0 diameters of a. s. eye. Eye area occupies more than 0.7 width of head; eyes small, a. m. eye a little smaller than the others. Posterior eye row slightly procurved; p. m. eyes about 1.1 diameters apart, same distance from side eye. Anterior row straight; a. m. eyes about 0.6 diameter apart, about 0.8 diameter

EXPLANATION OF PLATE VI

61. *Grammonota salicola* new species. Epigynum. 62. *Gnathantes fusca* Chamberlin and Ivie. Epigynum. 63. *Hilaria garrina* new species. Cephalothorax of ♂, lateral view. 64. *Hilaria garrina* new species. Epigynum, ventral view. 65. *Hilaria garrina* new species. Epigynum, ventral view. 66, 67. *Hilaria garrina* new species. Male palpus, two views. 68. *Hilaria garrina* new species. Patella and tibia of ♂ palpus. 69. *Montilaira relicta* new species. Epigynum, ventral view. 70. *Montilaira relicta* new species. Epigynum, caudal view.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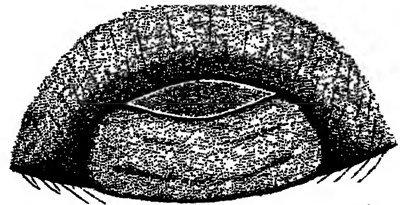
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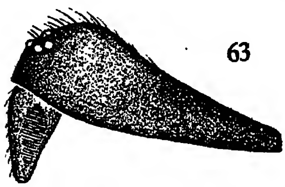
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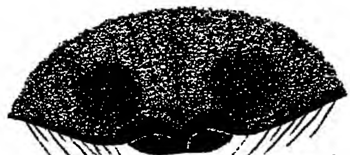
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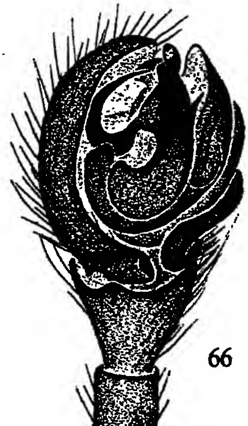
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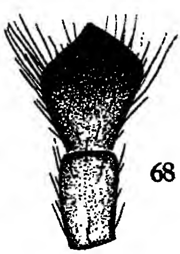
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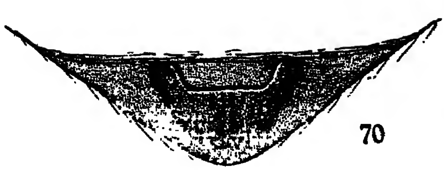
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69

from side eye. Median ocular quadrangle about as wide as long, wider behind. Palpus similar to that of *brunnea* and *placida*, with differences in the spur on the tibia;. palpal organs similar. The spur on the tibia has a slight double curve when seen from dorsal view, that of *placida* is straight.

Male, female.—Chelicerae small, vertical; fang with usual double curve. Sternum large; separates hind coxae by about 1.5 diameters. Abdomen moderately large; entire dorsum of both sexes, except posterior tip, covered with a moderately convex sclerite. A large sclerite in front of spinnerets below; another sclerite at each end of genital furrow, which is fused with the epigastric plates.

Female.—Carapace not quite as wide as in the male; head slightly humped back of the eyes. Eyes similar to those of male. Epigynum as in *brunnea*, etc.

Measurements:

	♂		♀	
	Mm.	*Ratio*	*Mm.*	*Ratio*
Length	1.45	223	1.65	220
Carapace:				
Length	0.65	100	0.75	100
Width	0.62	95	0.65	87
Tibia-patella:				
1	0.60	92	0.57	76
4	0.60	92	0.65	87

Type locality.—IOWA: 1935, Floyd Andre, 2 ♂ ♀.

Other records.—IOWA: Benton Co., 1935, F. Andre, ♀; Davis Co., 1935, F. Andre, ♀; Union Co., 1935, F. Andre, ♀. (Dorsal sclerite a little smaller than usual.)

Ceratinella diversa, new species

Figs. 19, 20

Male, female.—Color: Carapace dark brown, more or less marked with dusky. Chelicerae and endites light brown, marked with dusky. Sternum and labium dark dusky brown. Legs and palpi orange brown, more or less shaded at the joints; male palpus brown. Abdomen with dorsal sclerite reddish brown, shaded with dusky around the border, with or without four dark dots near center; sides and venter dark purplish gray; ventral sclerites light reddish brown. Epigynum light reddish brown to dusky brown. Spinnerets light brown.

Structure: Size medium to small.

Male.—Carapace broadly ovoid. Clypeus vertical; height about 2.5 diameters of a. s. eye. Eye area occupies about 0.7 width of head; a. m. eyes decidedly smaller than the others. P. m. eye about 1.1 diameters apart, 1.0 diameter from side eye. Anterior row straight; a. m. eye 0.5 diameter apart, 0.8 diameter from side eye. Median ocular quadrangle a little longer than wide, wider behind. Chelicerae, sternum and abdomen typical. Palpus typical, with tibial spur moderately long, straighter than in *placida*.

Female.—Carapace moderately broad; head moderately wide, head slightly convex back of eyes. Clypeus vertical; height 2.5 diameters of a. s. eye. Eye area occupies about 0.7 width of head, a. m. eye smaller than the others. Posterior eye row slightly procurved; p. m. eye about 1.8 diameters apart, 1.2 diameters from side eye. Anterior

row straight; a. m. eye about 0.6 diameter apart, 0.7 diameter from side eye. Median ocular quadrangle slightly longer than wide; wider behind. Dorsal sclerite of abdomen large and flat, nearly round, covers most of dorsal surface. Epigynum similar to that of *brunnea*, etc.

Type locality.—MINNESOTA: 8 mi. S. E. Warren, June 12, 1945, ♂ 2 ♀.

Ceratinella brunnea Emerton

Figs. 14, 15

Ceratinella brunnea Emerton, 1882, Trans. Conn. Acad. Sci., 6: 36; *8: 3.

Male, female.—Color: Carapace dark brown; eyes on black spots. Chelicerae and endites light brown, with pale tips. Sternum and labium dusky brown. Legs and palpi bright yellow, distal part of male palpus darker, brown. Abdomen with dorsal sclerite bright reddish brown at the center, broadly dusky around the margins, with four dark dots near the center (two of these may be indistinct at times); sides dark gray; venter usually a little lighter gray, separated from the side area by a row of pale dots; ventral sclerites light reddish brown. Spinnerets pale brown. Epigynum light reddish brown to dusky brown.

Structure: Size medium to small. Carapace short, broad, and rounded in the male, more nearly normal in the female. Clypeus vertical; height about 2.5 diameters of a. s. eye. Eye area occupies about 0.7 width of head; a. m. eye decidedly smaller than the others, somewhat conical. Posterior eye row very slightly procurved; p. m. eye about 1.0 diameter apart, about 1.0 diameter from side eye (sometimes 0.9 diameter apart). Anterior row straight; a. m. eye 0.3 diameter apart, 0.8 diameter from side eye. Median ocular quadrangle about as long as wide, wider behind.

Chelicerae vertical; fang with distinct double curve; fang groove without teeth on the margins. Sternum large four broad; truncate posterior end separates hind coxae by about 1.5 diameters. Abdomen of male with large dorsal sclerite covering almost entire dorsal surface, extending downward on the sides anteriorly. Epigastric sclerites broadly joined together across the middle, contains a distinct oval opening; with a large lunate sclerite in front of spinnerets. Abdomen of female with dorsal sclerite covering about three-fourths of each dimension and more flat than in the male; sclerite in front of spinnerets similar to male. Epigynum not significantly different from that of *C. buna.* Palpus typical; the spur on the tibia of medium length.

Measurements:

	♂ Mm.	♂ Ratio	♀ Mm.	♀ Ratio
Length	1.45	223	1.55	235
Carapace:				
Length	0.65	100	0.66	100
Width	0.60	92	0.57	86
Tibia-patella:				
1	0.54	83	0.50	76
4	0.56	76	0.60	91

Type locality.—NEW ENGLAND: Mt. Washington; cotypes from Salem, Saugus and New Haven.

Other records.—NEW YORK: Enfield Glen, ♂ ♀. QUEBEC: Montreal, October 16, 1923, 2 ♀, Crosby and Bishop. NORTH DAKOTA: Grand Forks, Sept., 1936, ♂, Joe Davis.

Ceratinella hemetha, new species

Ceratinella placida Crosby & Bishop, 1925 (in part), Bull. N. Y. State Museum, no. 264: 9*.
Ceratinella brunnea Chamberlin & Ivie, 1944, Bull. Univ. Utah, Biol. Ser., 8: 63.

Female.—Color: Carapace dark brown; eyes joined with black. Chelicerae and endites brighter, with pale tips. Sternum and labium dusky brown. Legs and palpi bright orange yellow. Abdomen with soft parts dark gray; dorsal sclerite moderately dark reddish brown; ventral sclerites reddish brown; epigynum shaded with dusky. Spinnerets light brown.

Structure: Size medium to small. Carapace essentially typical, with head narrower than usual. Clypeus vertical; height about 1.6 diameters of a. s. eye. Eye area occupies nearly the full width of the head; a. m. eye large, about as large as the others. Posterior eye row faintly procurved; p. m. eyes about 0.9 diameter apart, 0.6 diameter from side eyes. Anterior row straight; a. m. eye about 0.3 diameter apart, 0.2 diameter from side eye. Median ocular quadrangle about as long as wide, a little wider behind. Chelicerae slightly inclined; fang with usual double curve. Sternum and legs typical. Dorsal shield of abdomen large, covering nearly entire dorsal surface; ventral sclerites typical; abdomen covered with unusually long hair. Epigynum not significantly different from that of *brunnea.*

Measurements:

	♀ Mm.	♀ Ratio
Length	1.50	227
Carapace:		
Length	0.66	100
Width	0.57	86
Tibia-patella:		
1	0.50	75
4	0.58	88

Type locality.—GEORGIA: 4 mi. N. E. Sylvania, April 9, 1943, ♀.

Other records.—FLORIDA: Gainesville, February 10, 1942, ♀; W. side L. Newman, February 14, 1942.

This species closely resembles *holocerea* in color, size, and general structure. It differs chiefly in having the head narrower, the eyes larger, with the a. m. eye about as large as the others; the abdomen is covered with much longer hairs.

This is evidently the species which Crosby and Bishop (1925) redescribed as *placida.*

Ceratinella holocerea, new species

Female.—Color: Carapace brown, with faint radial streaks; eyes ringed with black, but interocular area not black. Chelicerae light reddish brown. Endites orange brown with pale tips. Sternum and labium dusky brown. Legs and palpi uniform yellowish. Abdomen dark gray on the soft parts; dorsal sclerite reddish brown, with four dusky dots and with margins dusky; ventral sclerites light reddish brown. Spinnerets light brownish.

Structure: Carapace normal for the genus; median groove absent; height of clypeus about 1.6 diameters of an a. s. eye. Anterior median eyes much smaller than the others. Anterior eye row faintly procurved;

a. m. eyes about 0.5 diameter apart, about 0.7 diameter from side eyes. Posterior row slightly procurved; p. m. eyes about 1.0 diameter apart, 0.9 diameter from side eyes. Chelicerae normal; fang with usual double curve. Sternum large and wide; hind coxae separated by about a length. Abdomen flattened; entire dorsum covered by a large, flat sclerite; a broad sclerite in front of the spinnerets. Epigynum not noticeably different from that of *brunnea.*

Measurements:

	♀ Holotype Mm.	Ratio
Length	1.55	235
Carapace:		
Length	0.66	100
Width	0.60	91
Tibia-patella:		
1	0.53	80
4	0.62	94

Type locality.—FLORIDA: Cocoa, Feb. 23, 1925, W. M. Barrows collector, ♀ holotype. In University of Utah collection.

Differs from *brunnea* mainly in the larger dorsal sclerite on the abdomen, which is more flat than in *brunnea.*

Ceratinella kenaba, new species

Female.—Color: Carapace brown. Chelicerae brown, lighter distally and mesally. Endites brown, with whitish tips. Sternum and labium dusky over yellowish brown. Legs and palpi light brown, with joints lighter. Abdomen with soft parts dark gray, sclerites orange brown. Spinnerets light brown.

Structure: Similar to *brunnea,* except the head is larger and more pronounced. Clypeus vertical; height about 2.0 diameters of a. s. eye. Eye area occupies 0.8 width of head; a. m. eye smaller than the others. Posterior eye row faintly procurved; p. m. eye about 0.9 diameter apart, 0.7 diameter from side eye. Anterior row straight; a. m. eye a little less than 0.3 diameter apart, 0.6 diameter from side eyes. Median ocular quadrangle slightly longer than wide. Epigynum not significantly different from that of *brunnea.*

Measurements:

	♀ Mm.	Ratio
Length	1.78	254
Carapace:		
Length	0.70	100
Width	0.61	87
Tibia-patella:		
1	0.56	80
4	0.67	96

Type locality.—FLORIDA: Hastings, ♀.

Ceratinella ornatula alaskana, new variety

Fig. 21

Ceratinella ornatula, Chamberlin and Ivie, 1947, Bull. Univ. Utah, Biol. ser., 10 (3): 31.

Female.—Color: Carapace dusky brown; eye area blackish. Chelicerae and endites light brownish, lighter at the tips. Sternum and labium dark dusky brown. Legs and palpi orange. Abdomen with

dorsal sclerite dark dusky brown; sides and venter dark gray, dotted with light gray; ventral sclerites reddish brown. Spinnerets light brown. Epigynum reddish brown and dusky.

Structure: Size medium; body obese and slightly depressed. Carapace essentially normal; rather broad, head slightly elevated. Clypeus very slightly protruding; height about 2.5 diameters of a. s. eye. Eye area occupies about 0.8 width of head; a. m. eye a little smaller than the others. Posterior eye row slightly procurved; p. m. eye about 1.1 diameter apart, 1.0 diameter from side eye. Anterior row slightly procurved; a. m. eye about 0.6 diameter apart, a 1.4 diameters from side eye. Median ocular quadrangle slightly longer than wide, wider behind.

Chelicerae small, reclined; fang normal, without the usual double curve. Sternum large, broad, as wide as long, truncate behind; separates hind coxae by 1.5 diameters. Legs moderately small. Abdomen large, rounded, somewhat depressed dorso-ventrally; with a large dorsal sclerite, which is nearly round, and which covers the entire dorsal surface except for a narrow margin all around; with a small sclerite at each end of the genital furrow which joins the epigynum plates. Epigynum somewhat elevated anteriorly; with a small cup-like depression on anterior edge; posterior structures typical.

Measurements:

	♀ *Mm.*	*Ratio*
Length	1.90	253
Carapace:		
Length	0.75	100
Width	0.71	95
Tibia-patella:		
1	0.70	93
4	0.80	107

Type locality.—ALASKA: Palmer, October 16, 1943, ♀, J. C. Chamberlin.

Ceratinella placida Banks

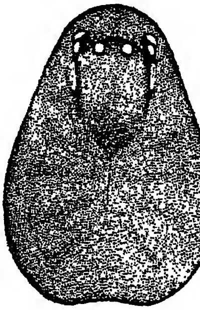
Figs. 22, 23

Ceratinella placida Banks, 1892, Proc. Phil. Acad. Sci., p. 32; *2: 54.

Male, female.—Color: Carapace dark brown. Chelicerae light brown. Endites light brown, with whitish tips. Sternum and labium dusky brown. Legs and palpi light yellowish brown; tibia and tarsus of male palpus brown. Abdomen with soft parts dark gray; sclerites dark reddish brown; dorsal sclerite shaded with dusky on borders. Spinnerets light brown.

EXPLANATION OF PLATE VII

71. *Lophomma columbia* new species. Cephalothorax, dorsal view. 72. *Lophomma columbia* new species. Cephalothorax, lateral view. 73. *Lophomma columbia* new species. Epigynum, ventral aspect. 74. *Lophomma columbia* new species. Epigynum, caudal aspect. 75. *Lophomma columbia* new species. ♂ palpus. 76. *Lophomma columbia* new species. Patella, tibia and bars of cymbium of ♂ palpus. 77. *Oedothorax cascadeus* new species. Epigynum, ventral aspect. 78. *Oedothorax cascadeus* new species. Epigynum, caudal aspect. 79. *Sciastes tenna* new species. Epigynum, ventral view. 80. *Sciastes tenna* new species. Epigynum, caudal view.



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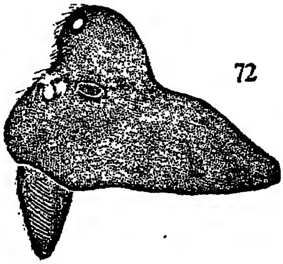

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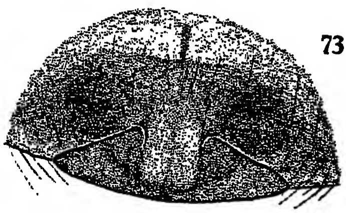

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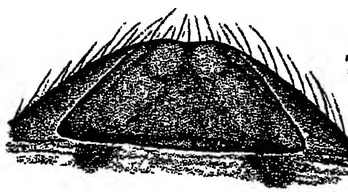

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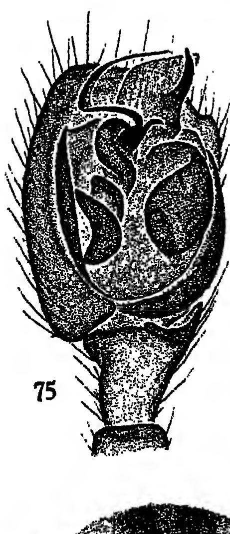

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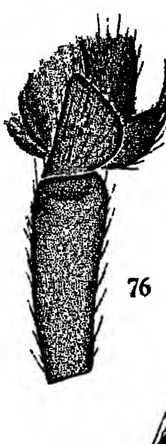

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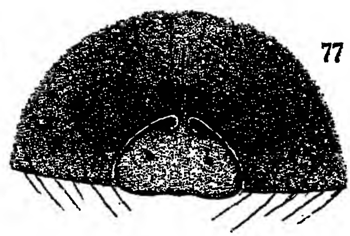

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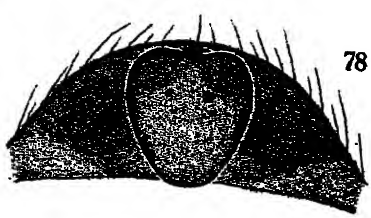

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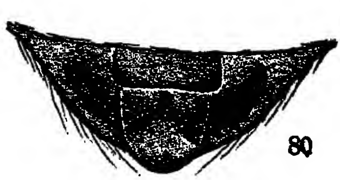

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Structure: Size medium; moderately robust. Carapace typical; a little wider in male, otherwise similar in both sexes. Clypeus vertical; height 2.5 diameters of a. s. eye in female, 3.0 diameters in male. Eye area occupies nearly 0.8 width of head; a. m. eye much smaller than the others, lens tends to be conical in shape. Posterior eye row very slightly procurved; p. m. eye about 1.1 diameters apart, 1.1 diameters from side eyes. Anterior row straight; a. m. eye about 0.5 diameter apart, 0.9 diameter from side eye. Median ocular quadrangle a little longer than wide, wider behind.

Chelicerae typical; fang with usual double curve. Sternum and legs typical. Abdomen with dorsal sclerite in both sexes; large, covering entire dorsum in male; smaller, covering one-half to two-thirds of the diameters of the abdomen in the female. Ventral sclerites typical. Epigynum not significantly different from that of ***brunnea***.

Male palpus similar to ***brunnea*** except that the spur on the tibia is long.

Measurements:

	♂ Mm.	♂ Ratio	♀ Mm.	♀ Ratio
Length	1.60	235	1.80	240
Carapace:				
Length	0.68	100	0.75	100
Width	0.64	94	0.65	87
Tibia-patella:				
1	0.62	91	0.61	81
4	0.67	99	0.72	96

Type locality.—NEW YORK: Ithaca.

Other records.—ALASKA: Homer, July 20–25, 1945, J. C. Chamberlin. MICHIGAN: Albion, June 16, 1933, ♀, W. Ivie. ONTARIO: So. Tea Lake, Algonquin Park, July 3 and 10, 1945, ♂♂ ♀♀, W. Ivie and T. B. Jurata.

Ceratinella tigana, new species

Fig. 24

Certinella placida (in part), Chamberlin and Ivie, 1947, Bull. Univ. Utah, Biol. Ser., 10(3): 30.

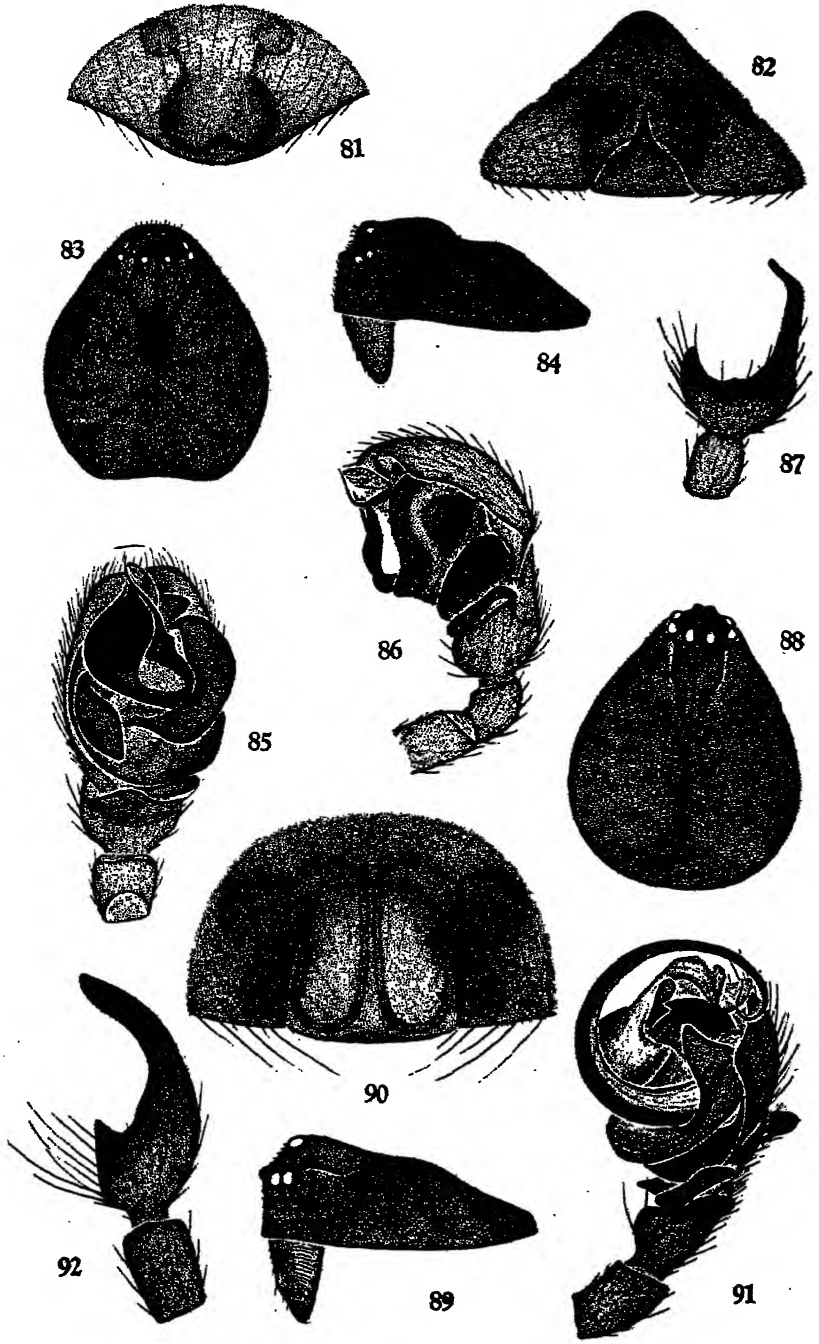
Female.—Color: Carapace dark brown. Chelicerae and endites brown, with lighter tips. Sternum and labium dusky brown. Legs and palpi orange brown. Abdomen with soft parts dark purplish gray; dorsal sclerite dark brown; ventral sclerites lighter brown, the one surrounding the spinnerets crossed radially with bands of dusky at the sides and above.

Structure: Size medium to small. Structure essentially typical.

EXPLANATION OF PLATE VIII

82. ***Spirembolus vasingtonus*** new species. Epigynum. 83. ***Minyriolus pampia*** new species. Cephalothorax, dorsal view. 84. ***Minyriolus pampia*** new species. Cephalothorax, lateral view. 85. ***Minyriolus pampia*** new species. ♂ palpus, ventral view. 86. ***Minyriolus pampia*** new species. ♂ palpus, sublateral view. 87. ***Minyriolus pampia*** new species. Patella and tibia of ♂ palpus. 88. ***Minyriolus plenus*** new species. Cephalothorax, dorsal view. 89. ***Minyriolus plenus*** new species. Cephalothorax, lateral view. 90. ***Minyriolus plenus*** new species. Epigynum. 91. ***Minyriolus plenus*** new species. ♂ palpus. 92. ***Minyriolus plenus*** new species. Patella and tibia of ♂ palpus.

PLATE VIII



Carapace wide in thoracic part Clypeus vertical, height about 2 8 diameters of a s eye Eye area occupies about 0 8 width of head, a m eye smaller than the others, lens conical Posterior eye row slightly procurved, p m eye about 1 0 diameter apart, 0 9 diameter from side eye in type (1 6 diameters apart, 0 8 diameter from side eye in paratype) Anterior row slightly procurved, a m eye about 0 6 diameter apart, 0 7 diameter from side eye, (0 5 diameter apart, 0 9 diameter from side eye in paratype) Median ocular quadrangle a little wider than long, wider behind Chelicerae vertical, fang with usual double curve

Legs and sternum normal Abdomen with large dorsal sclerite, covering about 0 70 of length and 0 75 of width, edge slightly irregular, spinnerets completely surrounded by a moderately wide sclerite Epigynum similar in shape to that of *brunnea*, except the middle lobe is not distinctly separated from anterior part

Measurements

	♀ Mm	Ratio
Length	1 75	250
Carapace		
Length	0 70	100
Width	0 66	94
Tibia patella		
1	0 60	86
4	0 66	94

Type locality—ALASKA Haines, August 23, 1945, ♀, J C Chamberlin, Matanuska, August-October, 1943, J C Chamberlin (paratype)

This species differs from *placida* mainly in smaller size, narrower head, spinnerets completely surrounded with a sclerite, in *placida* the sclerite extends only about half way around, epigynum different in structure of middle lobe

In spite of the differences in eye distances of the two specimens, they undoubtedly belong to the same species

Ceratinella tosior, new species

Female—Color Carapace dark brown Chelicerae brown, light brown distally Endites brown, with grayish white tips Sternum and labium dark dusky brown Legs and palpi light brown, the coxae narrowly bordered with dusky at distal end Abdomen with sclerites dark reddish brown, the dorsal sclerite shaded with dusky on the borders, rest of abdomen dark slate gray Spinnerets light brown Epigynum mostly reddish brown

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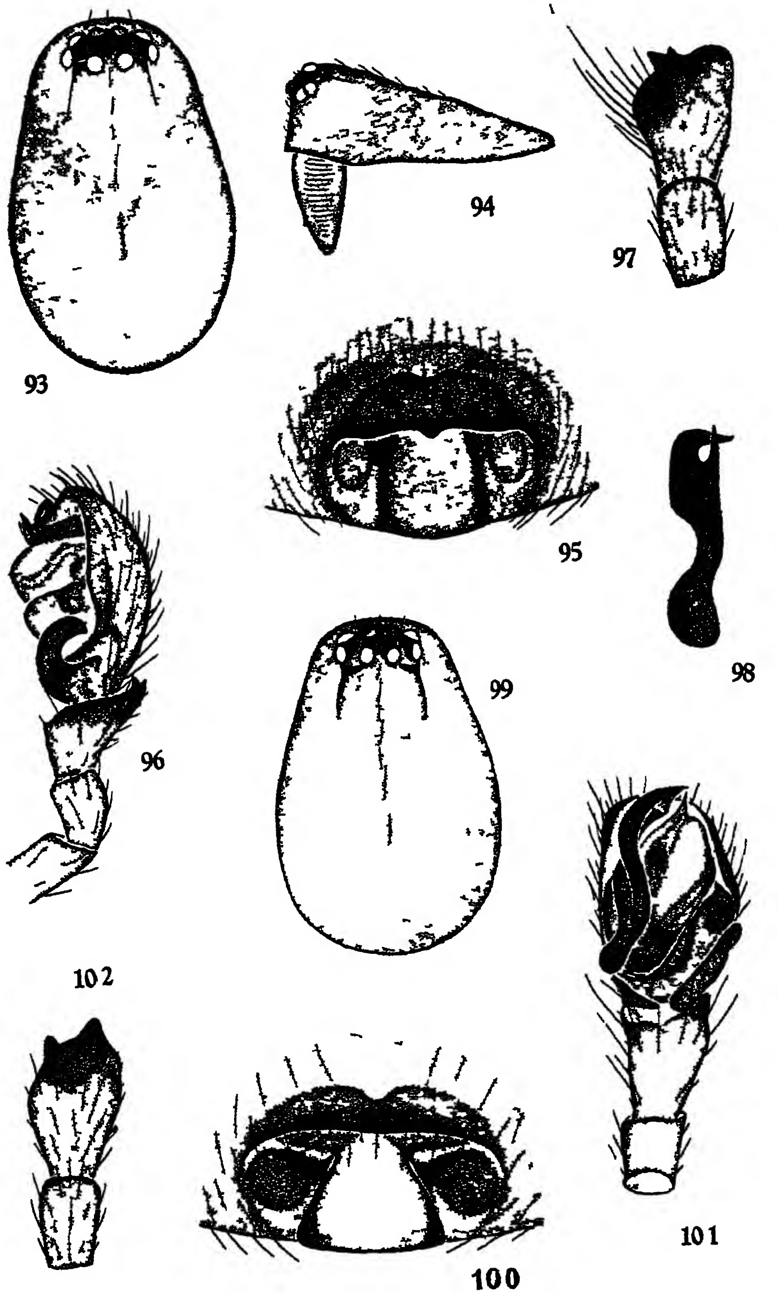
EXPLANATION OF PLATE IX

93 *Masoncus nogales* new species Cephalothorax, dorsal view 94 *Masoncus nogales* new species Cephalothorax and chelicerae, lateral view 95 *Masoncus nogales* new species Epigynum 96 *Masoncus nogales* new species ♂ palpus lateral view 97 *Masoncus nogales* new species Patella and tibia of ♂ palpus 98 *Masoncus nogales* new species Mesoventral view 99 *Masoncus arienus* new species Cephalothorax, dorsal view 100 *Masoncus arienus* new species Epigynum 101 *Masoncus arienus* new species ♂ palpus, ventral view 102 *Masoncus arienus* new species Patella and tibia of ♂ palpus dorsal view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Structure: Size medium to small. Carapace typical. Clypeus vertical; height a full 2 diameters of a. s. eye. Eye area occupies nearly 0.8 width of head; a. m. eye smaller than the others. Posterior eye row slightly procurved; p. m. eye about 1.1 diameters apart, 1.0 or 0.9 diameter from side eye. Anterior row faintly procurved; a. m. eye about 0.4 diameter apart, 0.7 diameter from side eye. Chelicerae, sternum, and legs typical. Abdomen of usual shape; dorsal sclerite large, nearly flat, covers nearly 0.75 of length, more than 0.75 of width; sclerite in front of spinnerets extends forward more than usual, extends about 0.4 distance from spinnerets to genital furrow. Epigynum not significantly different from that of *brunnea.*

Measurements:

	♀ Mm.	Ratio
Length	1.65	246
Carapace:		
Length	0.67	100
Width	0.60	90
Tibia-patella:		
1	0.50	75
4	0.57	85

Type locality.—MISSOURI: Columbia, July, 1905, ♀.

This species is very close to *brunnea*, but can be readily distinguished by its darker color. The legs are light brown instead of bright golden yellow. The abdominal sclerites are dark reddish brown, instead of bright reddish brown.

Genus **Ceratinops** Banks, 1905

Amer. Naturalist, 39: 309.

Generotype: *Ceratinops annulipes* (Banks).

Ceratinops uintana, new species

Figs. 27, 28

Female.—Color: Carapace dark shiny brown. Chelicerae reddish brown. Endites reddish brown with pale tips. Sternum and labium dark dusky brown. Legs and palpi brownish yellow. Abdomen dark gray; sclerite around spinnerets reddish brown, crossed by radial bands of dusky. Spinnerets orange brown. Epigynum dusky brown.

Structure: Size about that of a *Ceratinella.* General structure slightly flattened and broadened. Carapace ovoid; head narrow and slightly elevated. Height of clypeus about 3.0 diameters from a. s. eye. Eye area occupies three-fourths width of head at posterior lateral eyes. Posterior eye row strongly procurved; eyes about a diameter apart.

Anterior eye row slightly procurved; a. m. eyes about 0.5 diameter apart, about 1.1 diameters from much larger side eyes. Median ocular quadrangle longer than wide, wider behind than in front.

Chelicerae vertical; fang groove with four small teeth in front, four denticles behind. Sternum truncate behind, separating hind coxae by more than a diameter. Legs moderately short; leg 4 decidedly longer than leg 1. Abdomen flattened and broadened; with a sclerite

surrounding the spinnerets. Epigynum small; two openings; posterior sclerite broad and short.

Measurements:

	♀ Mm.	Ratio
Length	1 85	247
Carapace:		
Length	0.75	100
Width	0.65	87
Tibia-patella:		
1	0.65	89
4	0.77	103

Type locality.—UTAH: Mirror Lake, Uintah Mts., September 22, 1932, ♀; August 18, 1942.

Other record.—UTAH: Provo River at Cobble Rest, September 24, 1932, ♀.

Genus **Ceratinopsis** Emerton, 1882

Trans. Conn. Acad. Sci., 6: 36.

Generotype: *Ceratinopsis interpres* (Cambridge).

Ceratinopsis eutypa, new species

Fig. 36

Female.—Color: Carapace light brown; eyes on black spots. Chelicerae and endites reddish brown, lighter at the distal ends. Sternum and labium dusky brown. Legs and palpi light yellowish brown. Abdomen black. Spinnerets and epigynum dusky brown.

Structure: Size medium. Carapace essentially normal. Height of clypeus about 2.5 diameters of a. s. eye. Eyes slightly raised; a. m. eyes much smaller than the others; eye area occupies about 0.6 width of head. Posterior eye row straight; p. m. eye 1.9 diameters apart, 0.9 diameter from side eyes. Anterior row straight; a. m. eyes 0.8 diameter apart, 1.1 diameters from side eye. Median ocular quadrangle very slightly longer than wide, wider behind than in front.

Chelicerae vertical, moderately stout; front bears a number of setigerous granules, especially on the ectal corner; fang groove with five large teeth in front, four small teeth behind. Sternum normal; separates hind coxae by about a diameter. Epigynum, as seen from ventral view, consists of a small plate, straight across rear, somewhat narrowed anteriorly, with a large median point extending forward over the rim with an obtusely angular ridge far forward near the pedicel.

Measurements:

	♀ Mm.	Ratio
Length	2.10	200
Carapace:		
Length	1.05	100
Width	0.75	71
Tibia-patella:		
1	1.00	95
4	1.03	98

Type locality.—WASHINGTON: Rainier Park, August 9, 1929, ♀, R. V. Chamberlin.

Other records.—BRITISH COLUMBIA: Parksville, Sept. 13, 1935, ♀, W. Ivie; Sidney, V. I., Sept. 16, 1935, ♀, W. Ivie. OREGON: Comstock, Sept. 9, 1935, ♀, R. V. Chamberlin.

Ceratinopsis (?) oregonicola, new species

Fig. 37

Female.—Color: Carapace light yellowish brown, with radial streaks and sides of head a slightly darker brown, and with a large diffuse pale spot on back of head; eyes on black spots. Chelicerae light yellowish brown. Endites orange with pale tips. Sternum light yellowish brown, labium lightly shaded with dusky. Legs and palpi pale brown, with joints a little lighter. Abdomen gray. Spinnerets pale yellowish. Epigynum yellowish brown and light dusky.

Structure: Size small. Carapace normal; top of head moderately convex; clypeus nearly vertical, very slightly protruding, height about 1.8 diameters of a. s. eye. Eye area occupies about 0.6 width of head; a. m. eyes much smaller than the others. Posterior eye row faintly recurved; p. m. eye about 0.9 diameter apart, 0.8 diameter from side eyes. Anterior row straight; a. m. eye about 0.4 diameter apart, 0.6 diameter from side eyes. Median ocular quadrangle barely wider than long, much wider behind than in front.

Chelicerae slightly reclined; stridulating file weak; fang groove with five teeth in front, four teeth behind. Sternum moderately large, slightly convex; separates hind coxae by slightly more than a diameter. Legs moderately short. Abdomen normal. Epigynum has a widely extended posterior sclerite which is joined to the anterior rim by a narrow median isthmus to form a wide, inverted T-shaped structure; an open space between the posterior sclerite and the anterior rim near the middle of each side is filled with a smooth convex swelling; an anterior depression in front on each side.

Measurements:

	♀ *Mm.*	*Ratio*
Length	1.40	233
Carapace:		
Length	0.60	100
Width	0.48	80
Tibia-patella:		
1	0.46	77
4	0.56	93

Type locality.—OREGON: Jackson Co., April 6, 1927, 2 ♀, J. C. Chamberlin.

Ceratinopsis crosbyi, new species

Fig. 38

Female.—Color: Carapace brown, lightly marked with dusky. Chelicerae reddish brown. Sternum, labium, and endites dusky brown. Legs and palpi yellowish brown. Abdomen blackish. Spinnerets and epigynum dusky brown.

Structure: Size medium to small; structure essentially normal; body

slightly elongate. Eye area occupying about 0.7 width of head. Lateral eyes slightly more elevated than usual. Clypeus nearly vertical; height about 2.2 diameter of an a. s. eye. Eyes unequal, the descending order of size being a. s., p. s., p. m., a. m. Posterior eye row slightly procurved; p. m. eyes about 1.3 diameters apart, about 0.7 diameter from sides eyes. Anterior row faintly recurved; a. m. eyes about 0.4 diameter apart, about 1.0 diameter from side eyes. Median ocular quadrangle a little longer than wide, wider behind than in front. Chelicerae slightly reclined; fang groove with four large, short teeth in front. Legs normal; fourth leg distinctly longer than first. Epigynum has a large posterior plate, with a large median notch in front; openings separated and located anteriorly; a small elongate oval structure present on the median line between the openings.

Measurements

	♀ Mm.	Ratio
Length	1.80	225
Carapace:		
Length	0.80	100
Width	0.63	79
Tibia-patella:		
1	0.70	88
4	0.83	104

Type locality.—COLORADO: Pingree Park, Larimer Co., Aug. 20 1924, ♀, C. R. Crosby.

Ceratinopsis palomara, new species

Figs. 39, 40

Female.—Color: Carapace light brown, lightly marked with dusky; a distinct black spot below the a. m. eyes. Chelicerae light brown. Endites brownish orange with lighter tips. Sternum and labium dusky brown. Legs and palpi light brown. Abdomen gray. Spinnerets yellowish. Epigynum light yellowish and dusky brown.

Structure: Size medium. Carapace normal. Height of clypeus about 2.5 diameters of a. s. eye. Eyes about average; a. m. eyes much smaller than the others; eye area occupies about 0.6 width of head. Posterior eye row faintly recurved, p. m. eyes about 0.9 diameter apart, 0.8 diameter from side eyes. Anterior row straight; a. m. eyes 0.3 diameter apart, 1.1 diameter from side eyes. Median ocular quadrangle slightly wider than long; much wider behind than in front.

Chelicerae vertical; fang groove with five large teeth in front, four small teeth behind. Legs, sternum, and abdomen normal. Epigynum as shown in the figures.

Measurements:

	♀ Mm.	Ratio
Length	2.05	228
Carapace:		
Length	0.90	100
Width	0.75	83
Tibia-patella:		
1	0.91	101
4	0.95	106

Type locality.—CALIFORNIA: Santa Barbara.

Other record.—CALIFORNIA: Mt. Palomar (summit), July 26, 1931, ♀, R. V. Chamberlin and W. Ivie.

Ceratinopsis secuta, new species

Fig. 35

Female.—*Color:* Carapace light brown with diffuse dusky markings of the usual pattern. Chelicerae light brown. Endites dusky orange brown. Sternum and labium dark dusky brown. Legs and palpi light yellowish brown. Abdomen dark gray or black. Spinnerets dusky brown. Epigynum mostly white.

Structure: Size medium to large. Carapace essentially normal; head moderately broad, rounded across front, slightly convex back of eyes. Clypeus slightly protruding, height about 3.5 diameters of an a. s. eye. Median groove indistinct. Eye area occupies about 0.6 width of head; eyes moderately small, a. m. eyes much smaller than the others; lateral eyes slightly elevated. Posterior eye row slightly recurved; p. m. eyes about 1.0 diameter apart, 1.0 diameter from side eyes. Anterior row slightly recurved; a. m. eyes about 0.4 diameter apart, 1.5 diameters from side eyes. Median ocular quadrangle about as wide as long, much wider behind than in front.

Chelicerae vertical; fang groove with three large teeth in front, four or five smaller teeth, closely spaced, behind. Sternum wide in front, pointed behind; hind coxae separated by slightly less than a diameter. Abdomen moderately large. Spinnerets surrounded by a slightly elevated fold in the integument. Epigynum moderately large; middle part soft, white.

Measurements:

	♀ *Mm.*	♀ *Ratio*
Length	2.70	245
Carapace:		
Length	1.10	100
Width	0.85	77
Tibia-patella:		
1	1.08	99
4	1.10	100

Type locality.—CALIFORNIA: 15 mi. W. Santa Monica, March 20, 1941, 4 ♀, W. Ivie.

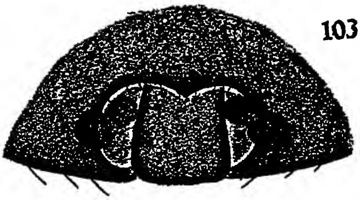
Ceratinopsis gosibia, new species

Figs. 29–32

Male, female.—*Color:* Carapace yellowish brown. Chelicerae and

EXPLANATION OF PLATE X

103. *Masoncus dux* new species. Epigynum. 104. *Scironis autor* new species. Epigynum. 105. *Scironis sima* new species. Palpus of ♂, ventral view. 106. *Scironis sima* new species. Tibia and patella of ♂ palpus, dorsal view. 107. *Scylaceus amylus* new species. Epigynum. 108. *Scylaceus divisus* new species. Epigynum. 109. *Spirembolus cheronus* new species. Epigynum, ventral view. 110. *Spirembolus cheronus* new species. Epigynum, caudal view. 111. *Spirembolus maderus* new species. Epigynum. 112. *Spirembolus orthus* new species. Epigynum. 113. *Cheraira kena* new species. Epigynum.



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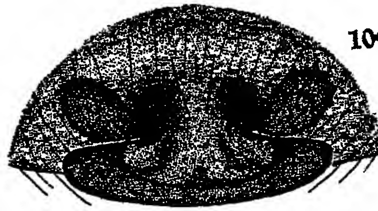

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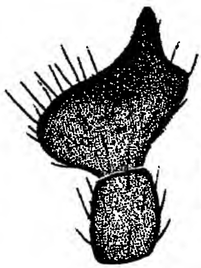

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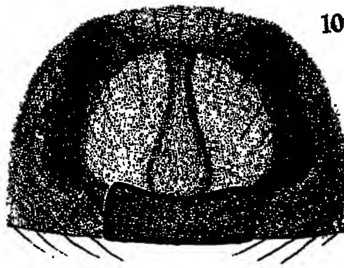

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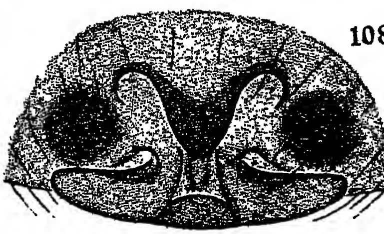

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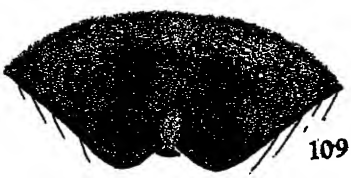

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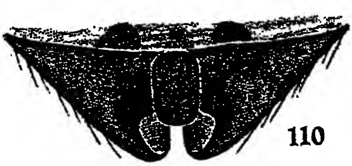

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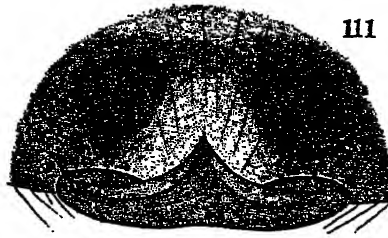

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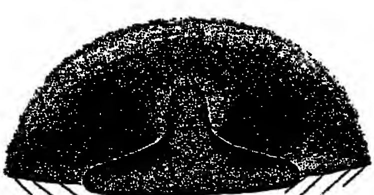

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endites light orange brown. Sternum brownish orange. Legs and palpi pale brownish yellow. Abdomen grayish white. Spinnerets light yellowish. Epigynum reddish brown and dusky.

Structure: Size medium. Carapace slightly broader than usual; head moderately broad, not modified in the male; median groove absent. Height of clypeus 2.5 to 3.0 diameters of an a. s. eye. Eye area occupies 0.7 width of head or more. Eyes subequal; size medium. Posterior eye row straight; p. m. eyes about 1.0 diameter apart, about 0.8 diameter from side eyes. Posterior row faintly procurved; a. m. eyes 0.3 diameter apart, 0.5 diameter from side eyes. Median ocular quadrangle about as wide as long, a little wider behind than in front.

Chelicerae vertical; moderately stout; fang groove with five teeth in front, three behind. Sternum large; separates hind coxae by more than 1.5 diameters. Legs slender; coxae short. Abdomen normal.

Palpus with patella short, scarcely longer than wide; tibia wide, broad projected ectad; cymbium normal; paracymbium vestigial, being a very small piece attached to ectal base of cymbium and bearing a few hairs. Embolic division with a hairy tail-piece, with a distal black spine, below the point of which is attached a long curved lash.

Epigynum with a large posterior plate, in front of which are the two openings separated by a narrow septum; in front, the epigynum is extended forward in a rounded process.

Measurements:

	♂ Mm.	♂ Ratio	♀ Mm.	♀ Ratio
Length	1.65	227	1.65	220
Carapace:				
Length	0.73	100	0.75	100
Width	0.60	82	0.60	80
Tibia-patella:				
1	0.70	96	0.70	93
4	0.75	103	0.77	103

Type locality.—ARIZONA: Creek 8 mi. No. Roosevelt Dam, April 11, 1935, ♂ ♀, W. Ivie.

Other record.—ARIZONA: No. Sasabe, January 1, 1941, ♀, D. and S. Mulaik.

Ceratinopsis interventa, new species

Fig. 34

Female.—Color: Carapace light yellowish brown; eyes on black spots. Chelicerae light brown. Endites yellowish Sternum and

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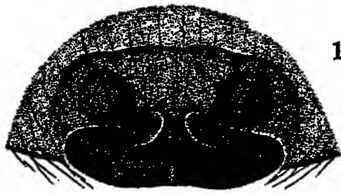
EXPLANATION OF PLATE XI

114. *Cheraira salmonis* new species. Epigynum. 115. *Cheraira castoris* new species. Epigynum. 116. *Cheraira willapa* new species. Epigynum. 117. *Tapinocyba* (?) *kesimba* new species. Epigynum. 118. *Tapinocyba kesimba* new species. Cephalothorax, lateral view. 119. *Tapinocyba kesimba* new species. Palpus of ♂, lateral view. 120. *Tapinocyba kesimba* new species. Palpus of ♂, embolic division, mesoventral view. 121. *Tapinocyba kesimba* new species. Patella and tibia of ♂ palpus. 122. *Tapinocyba sucra* new species. Epigynum, ventral view. 123. *Tapinocyba sucra* new species. Epigynum, caudal view. 124. *Tapinocyba iowa* new species. Epigynum, ventral view. 125. *Tapinocyba iowa* new species. Epigynum, caudal view.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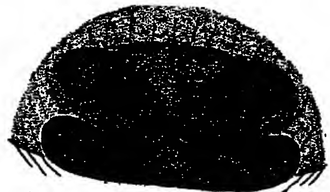
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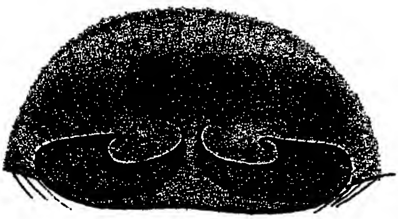
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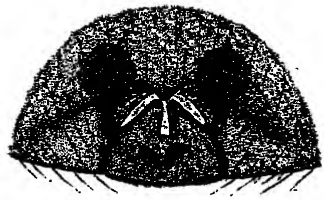
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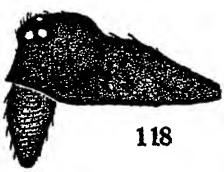
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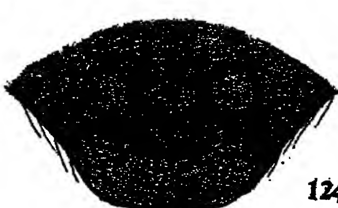
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labium dusky brown, darker on the margins. Legs and palpi yellowish. Abdomen light to dark gray. Spinnerets light brownish yellow. Epigynum yellowish, brownish and dusky.

Structure: Size medium; general shape moderately obese. Carapace essentially normal, moderately broad; median groove absent; clypeus slightly protruding, height about 1.6 diameters of a. s. eye. Eye area occupies about 0.8 width of head at posterior eye row; eyes moderately large; a. m. eyes a little smaller than others. Posterior eye row faintly recurved; p. m. eyes 0.9 diameter apart, 0.9 diameter from side eyes. Anterior row slightly procurved; a. m. eyes about 0.3 diameter apart, 0.5 diameter from side eyes. Median ocular quadrangle faintly wider than long, wider behind than in front. Chelicerae vertical, moderately stout; without stridulating file; fang groove with three teeth on each margin. Sternum moderately large and wide; separates hind coxae by a full diameter. Setae on legs and palpi moderately long and coarse. Abdomen large. Epigynum moderately large, with a transverse bar behind, in front of which is a large depressed plate, bearing a pair of dusky marks, and bordered on the sides with a black rim.

Measurements:

	♀	
	Mm.	*Ratio*
Length	2.00	267
Carapace:		
Length	0.75	100
Width	0.63	84
Tibia-patella:		
1	0.66	88
4	0.75	100

Type locality.—ARIZONA: Cr. 8 mi. No. Roosevelt Dam, April 11, 1935, 2 ♀.

Ceratinopsis (?) watsinga, new species

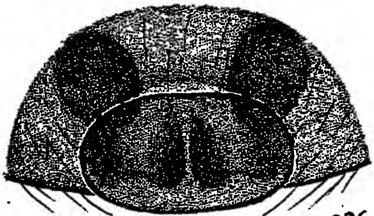
Fig. 33

Female.—Color: Carapace light yellowish brown; the a. m. eyes on a black spot. Chelicerae and endites light brownish orange. Sternum light brownish yellow; labium more dusky. Legs and palpi light yellowish. Abdomen pale gray. Spinnerets light yellowish. Epigynum yellowish brown and dusky.

Structure: Size medium. Carapace and head moderately broad. Height of clypeus about 4 diameters of a. s. eyes. Eye area occupies about 0.6 the width of the head. Eyes small, descending order of size being a. s., p. s., a. m., p. m. Posterior eye row straight; the small p. m.

EXPLANATION OF PLATE XII

126. *Tapinocyba phana* new species. Epigynum. 127. *Tapinocyba pontis* new species. Epigynum, ventral aspect. 128. *Tapinocyba pontis* new species. Epigynum, caudal aspect. 129. *Tapinocyba idahona* new species. Epigynum, ventral aspect. 130. *Tapinocyba idahona* new species. Epigynum, caudal aspect. 131. *Tigellinus perditus* new species. Epigynum. 132. *Tigellinus mesus* new species. Epigynum. 133. *Tachygyna watona* new species. Epigynum, ventral view. 134. *Tachygyna watona* new species. Epigynum, dorsal view. 135. *Tachygyna paita* new species. ♂ palpus, ventral aspect. 136. *Tachygyna paita* new species. Patella and tibia of ♂ palpus.



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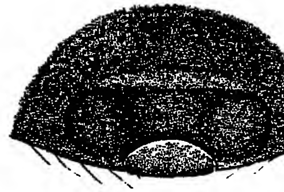

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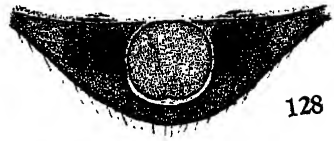

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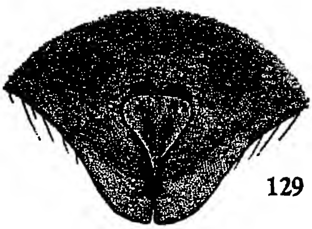

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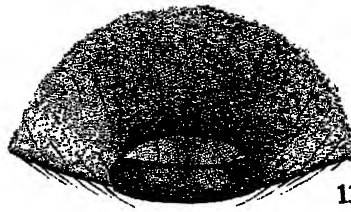

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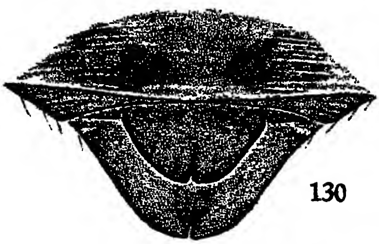

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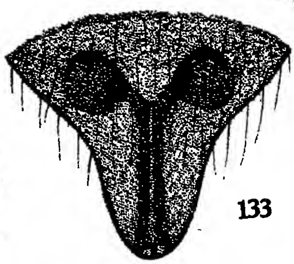

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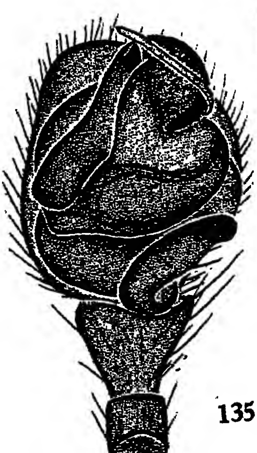

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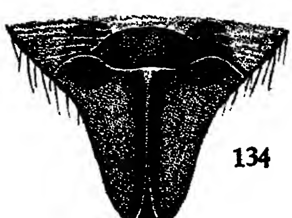

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eyes about 1.6 diameters apart, about 2 diameters from the side eyes. Anterior row slightly recurved; the a. m. eyes about 0.6 diameter apart, about 1.1 diameters from side eyes. Median ocular quadrangle slightly longer than wide, slightly wider behind than in front.

Chelicerae vertical; fang groove with five teeth in front. Sternum large; separates hind coxae by more than one diameter. Legs and palpi slender. Abdomen moderately large. Epigynum large, with a wide transverse plate behind, which contains the openings, and a stout conical process in front.

Measurements:

	♀ Mm.	Ratio
Length	1.75	233
Carapace:		
Length	0.75	100
Width	0.60	80
Tibia-patella:		
1	0.86	115
4	....	....

Type locality.—No data, but probably from vicinity of Salt Lake City, Utah, about 1930. ♀.

Genus **Cheraira** new

This genus is proposed for a group of western species agreeing among themselves in a distinctive form of the epigynum the features of which can best be appreciated from the figures for the several species described below. The affinition of the genus appear to be with *Spirembolus* and its allies, but in the lack of knowledge of the males cannot be determined definitely.

Orthotype: *Cheraira kena* new species.

Only the four new species described below are at present known to belong in this group.

Cheraira willapa, new species

Fig. 116

Female.—Color: Carapace brown, lightly marked with dusky. Chelicerae reddish brown. Endites orange brown with pale tips. Sternum and labium dark dusky over yellow. Legs and palpi bright yellowish orange. Abdomen blackish. Spinnerets brown, lightly shaded with dusky. Epigynum dusky brown.

Structure: Size moderately large. Carapace normal in outline; head slightly elevated. Clypeus slightly protruding; height about 3.5 diameters of a. s. eye. Eye area occupies about 0.6 width of head; a. m. eyes much smaller than the a. s. eyes, which are a little longer than the posterior eyes. Posterior eye row straight; p. m. eyes about 1.3 diameters apart, about 1.3 diameters from side eyes. Anterior row straight; a. m. eyes about 0.8 diameter apart, about 2.0 diameters from side eyes. Median ocular quadrangle about as wide as long, wider than in front.

Chelicerae vertical, stout, convex in front near base; fang groove with five large, widely spaced teeth in front, with four tiny teeth near

base of fang in rear. Sternum normal. Legs moderately robust. Epigynum with a wide transverse lobe, containing a pair of transverse openings anteriorly and mesally, separated by a short narrow septum; without small pits in front as in *castoris*.

Measurements:

	♀ Mm.	Ratio
Length	2.75	220
Carapace:		
Length	1.25	100
Width	0.90	72
Tibia-patella:		
1	1.15	92
4	1.25	100

Type locality.—WASHINGTON: Willapa R., August 8, 1929, 2 ♀, R. V. Chamberlin.

Other records.—WASHINGTON: Paradise Valley, July 17–22, 1932; Denny Cr. Camp, Snoqualine Pass, September 16, 1935. 8 ♀.

Cheraira kena, new species

Fig. 113

Female.—Color: Carapace light yellowish brown, with a black spot below the a. m. eyes and joining them. Chelicerae orange brown. Endites orange. Sternum and labium yellowish. Legs and palpi light orange brown. Abdomen light gray. Spinnerets pale orange brown. Epigynum light reddish brown and dusky.

Structure: Size large. Carapace normal; head slightly humped back of eyes. Height of clypeus about 3 diameters of an a. s. eye. Eye area occupies about two-thirds width of head at posterior eye row. Eyes moderately small; subequal, the descending order of size being a. s., p. s., p. m., a. m. Posterior eye row slightly recurved; p. m. eyes about 1.5 diameters apart, 1.2 diameters from side eyes. Anterior row faintly recurved; a. m. eyes about 0.3 diameter apart, about 1.0 diameter from side eyes. Median ocular quadrangle wider than long, much wider behind than in front.

Chelicerae nearly vertical, slightly reclined; fang groove with five long teeth in front, five small teeth behind. Sternum normal, separates hind coxae by about a diameter. Legs long, moderately robust. Abdomen moderately high and elongate, pointed behind; resembles a typical linyphiid. Epigynum large, with a wide transverse sclerite behind; in front of which are the openings separated by a narrow septum; in front, is a ridge, containing a pair of small cavities.

Measurements:

	♀ Mm.	Ratio
Length	2.65	232
Carapace:		
Length	1.14	100
Width	0.87	76
Tibia-patella:		
1	1.20	105
4	1.27	111

Type locality—UTAH Mirror Lake, Uintah Mts, July 28, 1936, 4 ♀, W Ivie

Other records—UTAH Ferron Res Wasatch Plateau, June 24, 1934, ♀, Ivie & Rasmussen

Cheraira castoris, new species

Fig 115

Female—*Color* Carapace light brown, lightly shaded with dusky Chelicerae and endites light orange brown Sternum and labium dusky brown Legs and palpi orange brown Abdomen medium gray Spinnerets yellowish Epigynum reddish brown and dusky

Structure Carapace normal, head slightly humped back of eyes Height of clypeus about 3 diameters of an a s eye Eye area occupies about two-thirds width of head Eyes small, a s largest, a m smallest Posterior eye row recurved, p m eyes about 1 0 diameter apart, 1 0 diameter from side eyes Anterior row straight, a m eyes subcontiguous, about a diameter or a little more from the side eyes Median ocular quadrangle a little wider than long, wider behind than in front

Chelicerae vertical, fang groove with five teeth on each side, those in front larger Epigynum large resembling *willapa* and *salmonis* with differences in details

Measurements

	♀ Mm	♀ Ratio
Length	2 50	227
Carapace		
Length	1 10	100
Width	0 80	73
Tibia patella		
1	1 02	93
4	1 10	100

Type locality—UTAH Beaver Canyon, June 7, 1934, 2 ♀, W. Ivie and H A Rasmussen

Cheraira salmonis, new species

Fig 114

Female—*Color* Carapace light brown with black spot on clypeus, including the a m eyes Chelicerae and endites light reddish brown Sternum light dusky yellow, labium dusky Legs and palpi yellow Abdomen light gray Spinnerets yellow Epigynum reddish brown

Structure Posterior eye row slightly recurved, p m eyes scarcely larger than a m eyes 1 3 diameters apart same distance from side eyes

EXPLANATION OF PLATE XIII

137 *Tachygyna sima* new species Epigynum ventral view 138 *Tachygyna sima* new species Epigynum dorsal view 139 *Tortembolus monicus* new species Epigynum 140 *Tortembolus approximatus* new species Cephalothorax and chelicerae of ♂ lateral view 141 *Tortembolus approximatus* new species Palpus of ♂ sublateral view 142 *Tortembolus approximatus* new species Patella and tibia of ♂ palpus 143 *Tortembolus approximatus* new species Epigynum ventral view 144 *Tortembolus approximatus* new species Epigynum caudal view 145 *Wubana reminiscens* new species Epigynum 146 *Willibaldia sodonta* new species Epigynum ventral view

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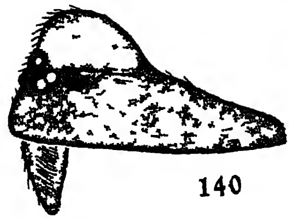

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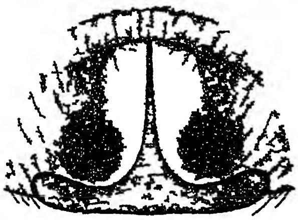

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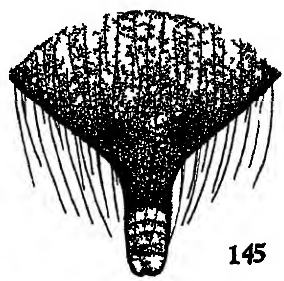

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144

Median ocular quadrangle about as wide as long. Epigynum as shown in the figures.

Measurements:

	♀ Mm.	Ratio
Length	1.95	230
Carapace:		
Length	0.85	100
Width	0.65	76
Tibia-patella:		
1	0.87	102
4	0.94	111

Type locality.—IDAHO: Salmon Falls, near Castleford, April 12, 1932, 2 ♀, J. C. Chamberlin.

Genus **Cochlembolus** Crosby, 1929

Ent. News 40: 79.

Generotype: *Cochlembolus alpinus* (Banks).

Cochlembolus provo, new species

Fig. 54

Carapace dull yellow, with a shield-shaped dusky area on posterior part of head and radiating dark lines on thorax, the lateral border of which is also black. Legs and endites yellow. Sternum and labium dusky yellow. Abdomen black throughout excepting a yellow ventral area in front of the genital furrow.

Posterior row of eyes distinctly recurved; median eyes more than their radius apart, closer to the laterals. Anterior row of eyes straight; eyes subcontiguous, the medians much smaller than the laterals. Quadrangle of median eyes much narrower in front than behind.

Epigynum as shown in fig. 54.

Length, 1.4 mm.

Type locality.—UTAH: Cobble Rest, Upper Provo River, July 30, 1936.

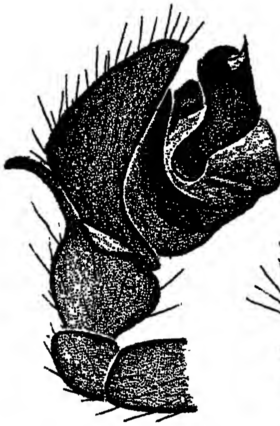
Genus **Coloncus,** new

A genus apparently related to *Araeoncus.* It is here set apart primarily on the basis of the distinctive structure of the epigynum which anteriorly is limited by a transverse ridge or sclerite behind which is a median septum which is narrow over its middle length and expanded into a deltoid plate caudally as shown in figs. 48–52.

Orthotype: *Coloncus pius* new species.

EXPLANATION OF PLATE XIV

147. *Zygottus corvallis* new species. Palpus of ♂, lateral view. 148. *Zygottus corvallis* new species. Patella and tibia of ♂ palpus, dorsal view. 149. *Zygottus corvallis* new species. Epigynum. 150. *Zygottus oregonus* new species. Epigynum, ventral view. 151. *Zygottus oregonus* new species. Epigynum, caudal view. 152. *Tapinocyba vermontis* new species. Epigynum. 153. *Tapinocyba* (?) *gamma* new species. Epigynum. 154. *Tapinocyba alpha* new species. Epigynum. 155. *Tapinocyba alpha* new species. ♂ palpus (holotype).



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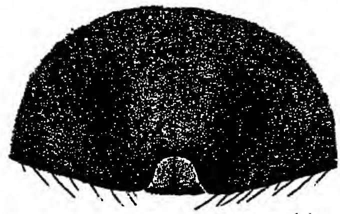

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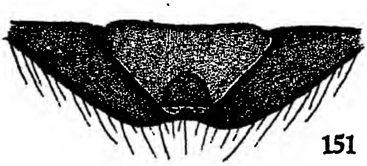

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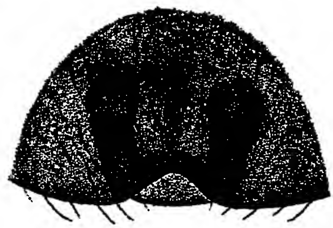

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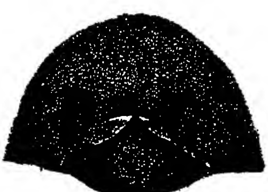

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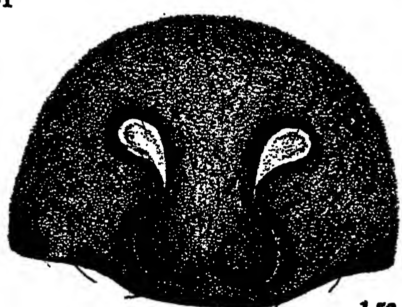

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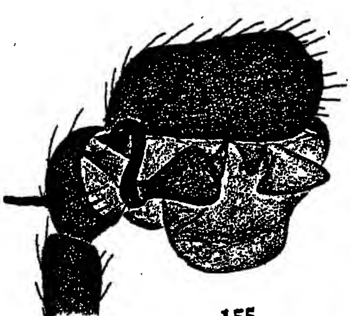

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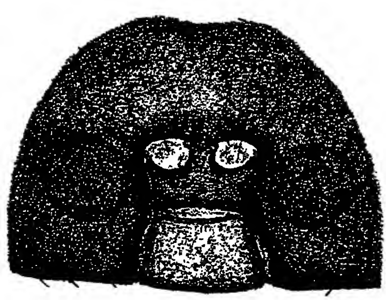

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Coloncus americanus (Chamberlin and Ivie), new combination

Fig. 51

Araenocus americanus Chamberlin and Ivie, 1944, Bull. Univ. Utah, Biol. Ser. 8(5): 58; *110. ♀.

Type locality.—GEORGIA: Bell to Washington; April 30, 1943, W. Ivie, ♀ holotype (Chamberlin & Ivie, 1944).

Coloncus cascadeus, new species

Female.—Carapace dull yellow with the usual dusky markings. Legs yellow without markings. Chelicerae dull yellow, more or less dusky. Sternum nearly black. Abdomen black throughout excepting the epigynal area.

Clypeus protruding, of the usual height. Posterior row of eyes straight; the medians their diameter or slightly more apart, closer to the laterals. Anterior row of eyes slightly procurved; median eyes smaller than the laterals, nearer to each other than to the laterals. Quadrangle of median eyes wider behind than in front.

The epigynum of the typical general form, differing from that of *siou*, for example, in having the posterior expansion of the septum more deltoid in shape, with the lateral ends not rounded but acute.

Length, of ♀ holotype, 1.75 mm.; of ♂ allotype, 1.1 mm.

Type locality.—COLORADO: W. of Cascade. Holotype, ♂, allotype ♀, and 1 ♂ and 1 ♀ paratype taken June 22, 1940.

A somewhat smaller species than *C. siou*. As the specimens representing it came to light after the plate accompanying this article had been made, drawings of the copulatory organs had to be saved for future publication.

Coloncus ocala, new species

Fig. 50

Female.—Carapace light brownish, with the usual pattern of dusky markings. Chelicerae light reddish brown. Labium and endites dusky, with whitish tips. Sternum blackish. Legs and palpi light yellow, with some dusky markings on coxae. Abdomen dark gray, nearly black. Spinnerets dusky yellow.

Structure: Normal. Anterior eye row faintly procurved; a. m. eyes smaller than the others, 0.6 diameter apart, 0.9 diameter from side eyes. Posterior row faintly recurved; p. m. eyes 0.9 diameter apart, 0.7 diameter from the side eyes. Median ocular quadrangle wider behind than in front, very slightly wider than long. Epigynum of the typical general form, with differences of proportion.

Measurements:

	♀ *Holotype* *Mm.*	*Ratio*
Length	1.65	220
Cephalothorax:		
Length	0.75	100
Width	0.55	73
Tibia-patella:		
1	0.64	85
4	0.73	97

Type locality.—FLORIDA: Ocala Forest, (W. 81° 43′ : N. 29° 10′), June 13, 1935. ♀ holotype taken June 13, 1935.

Other records.—FLORIDA: Gainesville, 2 ♀ ♀ taken Feb. 10, 1942.

Coloncus pius, new species

Fig. 52

Carapace brown, with the usual pattern of dusky markings. Chelicerae brownish, lighter distally and mesally. Labium and endites dusky brown, with light tips. Sternum blackish. Legs orange, lightly marked with dusky at the joints and on the coxae. Palpi more brownish. Abdomen blackish. Epigynum and spinnerets dusky brown.

Structure: Essentially normal. Larger than other known species. Clypeus slightly protruding, height about 3 diameters of an a. s. eye. Anterior eye row slightly procurved; a. m. eyes smaller than the laterals, about 0.5 diameter apart, about 1.2 diameters from side eyes. Posterior eye row straight; eyes equidistant, about 1.1 diameters apart. Median ocular quadrangle very slightly longer than wide, wider behind than in front. Chelicerae with file on ectal side; fang groove with four teeth in front and three behind. Epigynum of the usual form, close to that of *americana* and *wilsoni*, varying only in proportions and minor details.

Measurements:

	♀ *Holotype* *Mm.*	*Ratio*
Length	2.60	260
Cephalothorax:		
Length	1.00	100
Width	0.70	70
Tibia-patella:		
1	0.86	86
4	1.00	100

Type locality.—IDAHO: 4 mi. N. E. McCall (W. 116° 4′ : N. 44° 55′). ♀ holotype taken May 31, 1944.

This species is superficially different from the others in the genus by its larger size and somewhat lighter coloring.

Coloncus siou, new species

Figs. 48, 49

Female.—Carapace brown with the usual pattern of dusky markings. Chelicerae brownish, paler distally and mesally. Labium and endites dusky brown, with light tips. Sternum shiny blackish brown. Legs and palpi light brownish yellow, lightly shaded with dusky, more so on the coxae, distal part of palpi more brown. Abdomen dark gray to black. Spinnerets and epigynum dusky brown.

Structure: Essentially normal. Clypeus slightly protruding, height about 3 diameters of an a. s. eye. Anterior eye row slightly procurved; a. m. eyes smaller than the side eyes, about 0.7 diameter apart, 1.0 diameter from side eyes. Posterior row straight; eyes equidistant, about 1.1 diameters apart. Median ocular quadrangle about as wide as long; wider behind than in front. Chelicerae normal; fang groove with four teeth on front margin, three small teeth on hind margin.

Sternum large, convex, shiny, as wide as long; broad posterior

extension separating hind coxae by more than a diameter of one of them. Legs and palpi normal. Epigynum typical in general form. It closely resembles that of *ocala*, except for small details; but the spider is distinctly larger.

Measurements:

	♀ Holotype Mm.	Ratio
Length	2.00	250
Cephalothorax:		
Length	0.80	100
Width	0.66	82
Tibia-patella:		
1	0.77	97
4	0.88	110

Type locality.—NORTH DAKOTA: Hamlet (W. 103° 4′ : N. 48° 38′), ♀ holotype and ♀ paratype taken June 23, 1936 (Joe Davis collector).

Genus **Cornicularia** Menge, 1868

Preussische Spinnen, 226.

Generotype: *Cornicularia unicornis* Cambridge.

Cornicularia selma, new species

Fig. 53

Female.—Carapace yellowish brown, lightly marked with dusky; eyes on black spots. Chelicerae and endites light reddish brown. Sternum and labium dusky brown, darker around the edges. Legs and palpi brownish yellow. Abdomen blackish. Spinnerets light brownish yellow. Epigynum brownish-yellow and dusky.

Size medium to small. Carapace normal; back of head slightly convex. Height of clypeus about 2 diameters anterior side eyes. Eye area occupies little more than 0.7 width of head; anterior median eyes smaller than the others. Posterior eye row faintly recurved; posterior median eyes 0.9 diameter apart, 0.7 diameter from side eyes. Anterior row about straight; anterior median eyes about 0.4 diameter apart, 0.9 diameter from side eyes. Median ocular quadrangle slightly longer than wide, much wider behind than in front.

Chelicerae slightly reclined; stridulating file distinct; fang groove with five teeth in front, three behind. Sternum normal; separates hind coxae by about a diameter. Legs moderately short. Abdomen normal; epigastric plates with stridulating file.

Epigynum with a wide, somewhat triangular posterior sclerite as seen from ventral view; spermathecae and tubes visible.

Measurements:

	♀ Mm.	Ratio
Length	1.50	214
Cephalothorax:		
Length	0.70	100
Width	0.51	73
Tibia-patella:		
1	0.53	76
4	0.62	89

Type locality.—OREGON: Selma, April 6, 1937, J. C. Chamberlin, 2 ♀.

Genus **Corypheolana** Strand, 1914

Generotype: *Corypheolana holmgreni* (Thorell).

Corypheolana oatimpa, new species

Fig. 161

Carapace dusky to nearly black over yellow or light brown, the head above and anteriorly lighter; a fine median black line running forward to between the median eyes; a light spot on each side of middle line of head behind. Legs yellow; coxae and trochanters black in a line across distal end beneath. Sternum dusky to nearly solid black. Abdomen black throughout excepting the epigynum and spinnerets.

Posterior row of eyes straight or slightly procurved; medians about their diameter apart, slightly closer to the laterals. Quadrangle of median eyes longer than wide, narrower in front than behind. Anterior row of eyes definitely recurved; medians subcontiguous, a little farther from the laterals.

Epigynum as drawn (fig. 161).

Length of ♀, 2.4 mm.

Type locality.—WYOMING: Yellowstone Lake, Bridge Bay. Several ♀♀ taken June 20, 1938.

Genus **Disembolus** Chamberlin and Ivie, 1933

Bull. Univ. Utah, Biol. Ser., 2(2): 20–22.

Orthotype: *Disembolus stridulans* Chamberlin and Ivie.

Disembolus apache, new species

Fig. 163

Carapace dusky orange. Legs clear yellow. Sternum dusky over orange. Endites yellow and labium dusky or black. Abdomen throughout orange.

Posterior row of eyes recurved; median eye about their radius apart and twice as far from the laterals. Quadrangle of median eyes narrower in front than behind. Anterior row of eyes also a little recurved; medians very small, much closer to each other than to the laterals.

Epigynum as drawn (fig. 163).

Length, 2 mm.

Type locality.—ARIZONA: Willow Creek, near Birchell's Ranch (?). One ♀ taken in October, 1928.

The type is faded from long preservation and markings are no longer evident. The species seems clearly distinct in the form of the epigynum which has the general features of that of *D. stridulans* C. and I.; but the median septum is notably broader, the cross arms mesally thicker in the antero-caudal direction, etc.

Disembolus zygethus, new species

Figs. 42, 43

Female.—Color: Carapace yellowish brown; with dusky markings of the usual pattern. Chelicerae medium brown. Endites orange brown with lighter tips. Sternum and labium dusky brown. Legs yellowish with femora and tibia darkened; tarsi and metatarsi pale. Palpi light

yellowish brown Abdomen dark gray Spinnerets light brownish yellow Epigynum brownish and yellowish

Structure Size moderately large Carapace normal in outline, slightly elongate, cervical indentations extended over back of head, causing a depression in the profile head narrowed and slightly convex back of eyes, median groove very narrow, indistinct Clypeus nearly vertical, height about 3 diameters of a s eye Eye area occupies about 0 7 width of head Posterior row faintly procurved, p m eyes 0 8 diameter apart, 0 7 diameter from side eyes Anterior row slightly recurved, a m eyes 0 3 diameter apart, 0 4 diameter from side eyes Median ocular quadrangle longer than wide, wider behind than in front

Chelicerae vertical stridulating file coarse, fang groove with four large widely spaced teeth behind, none in front Sternum pointed behind, separates hind coxae by less than a diameter Palpi moderately large swollen on tibia and tarsus, especially at the joint between the two Legs moderately stout Epigynum moderately large, with a large, transverse posterior plate, which is deeply concave in the anterior middle, enclosing a pale extension from in front, openings are a pair of narrow slits between the posterior plate and the anterior extension

Measurements

	♀ Mm	♀ Ratio
Length	2 85	248
Cephalothorax		
Length	1 15	100
Width	0 80	70
Tibia patella		
1	1 00	87
4	1 20	104

Type locality—IDAHO North end Payette Lake, July 4, 1943, ♀, W Ivie

Genus **Eperigone** Crosby and Bishop, 1928

N Y State Mus Bull 27 46

Generotype *Eperigone trilobatus* (Emerton)

Eperigone socius, new species

Fig 159

Carapace light brown, dusky, with the usual darker radiating lines Legs dull yellow Sternum weakly dusky over a yellowish background Labium also dusky Abdomen black throughout

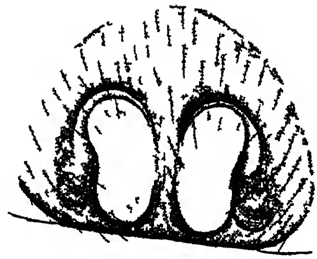
Distinguishable from other species in the form of the epigynum which is represented in fig 159

EXPLANATION OF PLATE XV

156 *Tapinocyba alpha* new species Tibia of left ♂ palpus, ectodorsal view 157 *Ceraticelus agathus* new species Epigynum 158 *Ceraticelus albus* (W Fox) Epigynum 159 *Eperigone socius* new species Epigynum 160 *Tigellinus ueber* new species Epigynum 161 *Corypheolana oatimpa* new species Epigynum 162 *Maso navajo* new species Epigynum 163 *Disembolus apache* new species Epigynum

PLATE XV

156



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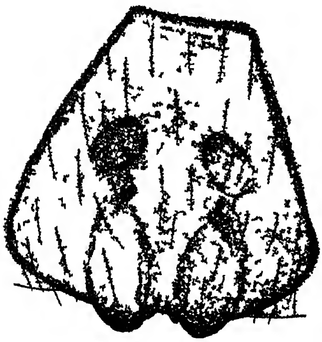

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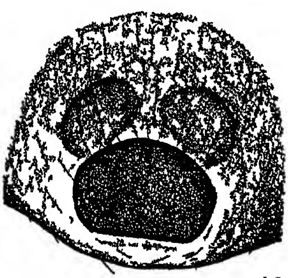

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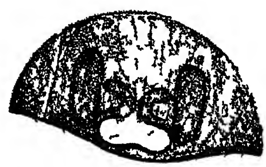

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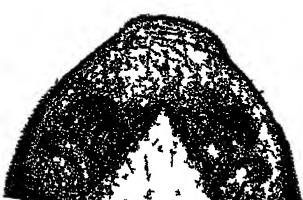

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Length of ♀ holotype, 2.2 mm.

Type locality.—WYOMING: Bridge Bay, Yellowstone Lake, ♀ holotype taken June 20, 1938.

From *E. holda* Chamberlin and Ivie, occurring in the same region, distinguishable in the different form of the epigynum.

Genus **Eularia** Chamberlin and Ivie, 1933

Bull. Univ. Utah, Biol. Ser., 2(2): 14.

Orthotype: *Eulaira dela* Chamberlin and Ivie.

Eularia kaiba, new species

Figs. 59, 60

Female.—*Color:* Carapace light brownish yellow, with faint dusky markings; eyes on black spots. Chelicerae and endites brownish orange. Sternum and labium dark dusky yellow. Palpi and legs light brownish yellow. Abdomen dark gray. Spinnerets light brownish yellow. Epigynum yellowish brown and dusky. Epigastric plates yellowish.

Structure: Size medium. Carapace normal; head moderately narrowed. Height of clypeus about 1.7 diameters of a. s. eye. Eye area occupies about three-fourths width of head. Eyes moderately large; a. m. eyes much smaller than the others. Posterior eye row straight to faintly procurved; p. m. eyes about 0.7 diameter apart, about 0.6 diameter from the side eyes. Anterior row straight to slightly recurved. A. m. eyes about 0.6 diameter apart, about 0.4 diameter from the side eyes. Median ocular quadrangle a little longer than wide, wider behind than in front.

Chelicerae slightly reclined; fang groove with five large teeth in front, five small teeth behind. Sternum, legs and abdomen normal. Epigynum very simple, consisting of a pair of small inconspicuous openings, widely separated.

Measurements:

	♀ Mm.	Ratio
Length	1.85	218
Cephalothorax:		
Length	0.85	100
Width	0.68	80
Tibia-patella:		
1	0.75	88
4	0.85	100

Type locality.—UTAH: Mirror Lake, Uintah Mts., July 28, 1936, ♀.

Eularia wioma, new species

Female.—*Color:* Carapace light brownish yellow, lightly touched with dusky. Chelicerae and endites orange. Sternum and labium dusky yellow. Legs and palpi light yellowish. Abdomen pale gray. Spinnerets yellowish. Epigynum yellowish and dusky.

Structure: Size medium to small. Structure essentially normal. Head slightly convex back of eyes. Height of clypeus about 1.7 diameters of a. s. eye. Eye area occupies about 0.6 width of head.

A. m. eyes much smaller than the others. Posterior row straight; eyes about 0.7 diameter apart. Anterior row straight; a. m. eyes about 0.5 diameter apart, about same distance from side eyes. Median ocular quadrangle a little longer than wide, wider behind than in front. Chelicerae slightly reclined; fang groove with three teeth in front, four tiny teeth behind. Epigynum simple, with opening concealed from ventral view.

Measurements:

	♀ *Mm.*	*Ratio*
Length	1.65	220
Cephalothorax:		
Length	0.75	100
Width	0.55	73
Tibia-patella:		
1	0.62	83
2	....	....

Type locality.—Wyoming: Bridge Bay, Yellowstone Lake; August 11, 1940, ♀.

Eularia quaestio, new species

Figs. 57, 58

Female.—*Color:* Carapace light brown, with the usual pattern of dusky markings. Chelicerae yellowish brown. Sternum, labium, and endites dusky. Legs and palpi light brown, lightly shaded with dusky. Abdomen dark gray. Spinnerets and epigynum dusky brown.

Structure: Size small. Structure essentially normal. Height of clypeus about 1.6 to 2.0 diameters of a. s. eye. Eye area occupying more than two-thirds width of head. Posterior eye row straight; p. m. eyes 0.9 diameter apart, 0.8 diameter from side eyes. Anterior row straight; a. m. eyes 0.4 diameter apart, 0.5 diameter from side eyes. Chelicerae vertical; fang groove with four or five small teeth in front, five tiny denticles behind. Sternum normal, separating hind coxae by a full diameter. Legs moderately short. Epigynum small, produced behind into a short, blunt point; openings consist of a pair of narrow longitudinal slits on the dorsal side.

Measurements:

	♀ *Mm.*	*Ratio*
Length	1.50	231
Cephalothorax:		
Length	0.65	100
Width	0.50	77
Tibia-patella:		
1	0.55	85
4	0.60	92

Type locality.—Manitoba: Churchill, June-July, 1936, 3 ♀, H. E. McClure.

Genus **Grammonota** Emerton, 1882

Trans. Conn. Acad. Sci., 6: 38.

Generotype: *Grammonota pictilis* (Cambridge).

Grammonota (?) salicicola, new species

Fig. 61

Female.—Color: Carapace brownish yellow, with distinct and rather heavy dusky markings. Chelicerae and endites light reddish brown. Sternum dusky, faded to yellowish in the middle; labium dusky. Legs and palpi bright yellow. Spinnerets yellow. Epigynum yellowish and dusky brown.

Structure: Size medium to small. Carapace broadly truncate behind; head moderately narrowed and slightly elevated. Height of clypeus about 2.3 diameters of a. s. eyes. Eye area occupies about 0.7 width of head. A. m. eyes much smaller than the others. Posterior eye row procurved, p. m. eyes about 1.0 diameter apart, 0.6 diameter from side eyes. Anterior row slightly procurved; a. m. eyes about 0.5 diameter apart, same distance from side eyes. Median ocular quadrangle longer than wide, wider behind than in front.

Chelicerae slightly reclined; fang groove with five teeth in front, four small teeth behind. Sternum large, convex; separates hind coxae by nearly a length. Legs and palpi normal. Abdomen large, broad and slightly flattened. Epigynum with a simple sub-quadrate depression behind somewhat as in a typical *Grammonota.*

Measurements:

	♀ *Mm.*	*Ratio*
Length	1.60	246
Cephalothorax:		
Length	0.65	100
Width	0.54	83
Tibia-patella:		
1	0.62	95
4	0.72	111

Type locality.—UTAH: Southwest of Salt Lake City, May 16, 1941, ♀, W. Ivie.

Genus **Hilaira** Simon, 1884

Arachnides de France, 5(2): 374.

Generotype: *Hilaria excisa* (Cambridge).

Hilaira garrina, new species

Figs. 63–68

Male, female.—Color: Carapace light brown, faintly marked with dusky. Chelicerae light reddish brown. Endites brownish orange. Labium and sternum dusky over yellow. Legs and palpi brownish yellow. Abdomen dark gray. Spinnerets yellowish.

Structure: Size moderately large; body somewhat elongate. Carapace moderately broad and flat; head slightly elevated and rounded, more so in the male. Eyes small; area occupying about three-fifths width of head. Anterior row slightly recurved; p. m. eyes about 0.3 diameter apart, about 1.0 diameter from larger side eyes. Posterior row straight or faintly procurved; p. m. eyes 1.0 diameter apart, 1.2 diameter from side eyes. Median ocular quadrangle about as wide as

long, wider behind than in front. Height of clypeus about 3.0 diameters of an a. m. eye in female, about 3.5 diameters in male.

Chelicerae vertical, moderately stout; fang groove with five large teeth in front, three or four teeth behind. Legs normal; 4, 1, 2, 3, in order of length; hind tibia with one seta above. Abdomen somewhat elongate. Epigynum small. Palpus of average size (details shown in figures).

Measurements:

	♂ Mm.	♂ Ratio	♀ Mm.	♀ Ratio
Length	2.82	207	3.40	250
Cephalothorax:				
Length	1.36	100	1.36	100
Width	1.09	80	1.06	78
Tibia-patella:				
1	1.27	93	1.27	93
4	1.36	100	1.38	101

Type locality.—COLORADO: Pike's Peak (about 13,700 ft.), June 22, 1940, ♂ holotype, ♀ allotype, ♂ ♀ paratypes, W. Ivie and A. L. Wilson collectors. Found under pieces of granite.

Close to *H. tatrica* Kulc.

Genus **Lophomma** Menge, 1867

Schr. Naturf. Ges. Danzig (N. F.) 2(1): 209.

Generotype: *Lophomma punctata* (Blackwall).

Lophomma columbia, new species

Figs. 71–76

Male, female.—Color: Carapace light brown, faintly marked with dusky. Chelicerae light brown. Endites pale orange brown, lighter at the tips. Sternum and labium dusky brown. Legs and palpi pale brown, palpal organs darker. Abdomen gray. Spinnerets light brown. Epigynum light yellowish brown and dusky.

Structure: Size medium. Male head and clypeus modified; carapace otherwise normal. Clypeus broad, rounded, protruding; height more than four times diameter of a. s. eye. Head with large central part highly elevated into a rounded lobe; a large oval pit back of each p. e. eye. Posterior eye row slightly procurved; p. m. eyes situated near top of hump, near front, about 1.5 diameters apart, nearly 4 diameters from lateral eyes. Anterior row strongly procurved; a. m. eyes small, located on front of hump, about 0.5 diameter apart, more than 4 diameters from a. s. eyes. Lateral eyes below and to the front of the cephalic hump. Median ocular quadrangle wider than long, much wider behind than in front. Chelicerae vertical; stridulating file distinct; fang groove with four large teeth in front, three or four small teeth behind. Sternum moderately large, with intercoxal points; hind coxae separated by slightly less than a diameter. Legs moderately long; tarsi longer than usual, slender. Abdomen normal; epigastric plates provided with a prominent stridulating file (the pick is on the posterior distal margin of coxae 4). Palpus of medium size. Femur

short. Patella long, nearly three times as long as wide, smooth on top. Tibia short and narrowed, slightly longer than wide, with a short angular projection above. Tarsus bent at nearly a right angle to the tibia. Cymbium with a conical projection at base above, which bears a cluster of stout spines; with a blunt projection toward distal end on ectal edge. A distal process arises back of the embolic division at distal end, divided into a stout spine and a broad lamella. Embolic division with tail-piece and middle part tightly twisted; embolus moderately long and slender, curved into a semi-circle.

Female.—Carapace slightly elongate, head moderately wide; clypeus rounded across front, height about 4 diameters of a. s. eye. Eye area occupies about 0.7 width of head. Posterior eye row straight; p. m. eyes about 1.3 diameters apart, 1.1 diameters from side eyes. Anterior row faintly procurved; a. m. eyes about 0.4 diameter apart, 1.9 diameters from side eyes. Chelicerae vertical; fang groove with five teeth in front, four small teeth behind. Both chelicerae and epigastic plates have stridulating files, but not as prominently as in the male. Legs long. Epigynum with a large posterior sclerite, which appears broad behind, from ventral view, but much narrower in front; openings small, widely separated.

Measurements:

	♂		♀	
	Mm.	*Ratio*	*Mm.*	*Ratio*
Length	1 75	219	1.75	219
Cephalothorax:				
Length	0.80	100	0.80	100
Width	0 60	75	0.60	75
Tibia-patella:				
1	0.80	100	0.80	100
4	0.87	109	0.90	112

Type locality.—BRITISH COLUMBIA: W. side Seanich Inlet, Sept. 14, 1945, ♂♂ ♀♀, Chamberlin and Ivie; L. Cameron, V. I., Sept. 13, 1935. Chamberlin and Ivie.

Genus **Maso** Simon, 1884

Arachnides de France, 5(3): 861.

Generotype: *Maso sundvalli* (Westring).

Maso marxi matanuskae, new variety

Maso sundevalli (Westr.), Chamberlin and Ivie, 1947.

Female.—Color: Carapace brown, lightly marked with dusky. Chelicerae light brown. Endites light brown with whitish tips. Sternum and labium dark dusky brown. Legs and palpi bright yellowish-orange. Abdomen dark gray above; light gray on sides and venter, darker around spinnerets. Spinnerets light brown. Epigynum dusky brown.

Structure: Size medium. Carapace ovoid, head rather narrow; median groove absent. Clypeus nearly vertical; height about 2.0 diameters of a. s. eye. Eye area occupies about 0.8 width of head; a. s. eye large, raised on tubercles. Anterior eye row slightly longer than posterior row; slightly procurved; a. m. eye small; about 0.5 diameter apart, about 2.0 diameters from side eye. Posterior row

slightly recurved; p. m. eye a 1.0 diameter apart, 0.9 diameter from side eye. Median ocular quadrangle slightly longer than wide, wider behind.

Chelicerae vertical; fang groove with four teeth in front, three small teeth behind. Sternum large, convex, as wide as long, truncate behind; separates hind coxae by more than a diameter. Legs moderately short and stout; tarsi much shorter than metatarsi. Epigynum moderately large; has two large openings beneath a raised ridge, separated by a narrow-septum.

Measurements:

	♀ *Mm.*	*Ratio*
Length	1.72	236
Cephalothorax:		
Length	0.73	100
Width	0.60	82
Tibia-patella:		
1	0.67	92
4	0.70	96

Type locality.—ALASKA: Matanuska, Sept., 1944, ♀, J. C. Chamberlin.

Close to *M. sundevalli* (W.), but the anterior lateral eyes are more protruding.

Maso navajo, new species

Fig. 162

Carapace dull yellow, a few long black setae in series along mid-dorsal line. Legs clear yellow. Sternum dusky over light orange. Endites yellow. Labium dusky. Abdomen entirely light grey or nearly white.

Posterior row of eyes straight; median eyes not fully their diameter apart, a little farther from the laterals; slightly longer than the anterior row. Quadrangle of median eyes narrower in front than behind and a little longer than wide. Anterior row of eyes distinctly procurved; median eyes relatively small, nearly contiguous with each other, but separated by about their radius from the laterals. Anterior margin of furrow of chelicera with five teeth of which the most proximal is more remote; teeth of posterior margin small, three or four in number.

Epigynum as drawn (fig. 162).

Measurements:

	♀ *Mm.*	*Ratio*
Length	2.20	275
Cephalothorax:		
Length	0.80	100
Width	0.70	85
Tibia-patella:		
4	0.10	125

Type locality.—ARIZONA: At a creek 8 mi. N. of Roosevelt Dam, ♀, April 11, 1935, Wilton Ivie.

Aside from differences in color, this species is distinguishable from the preceding and others in the form of the epigynum.

Genus **Masoncus,** new

The males in this genus have cephalic pits. The embolic division of the male palpus straight, distally bifid, the embolus proper short and straight, the other branch typically geniculate. Epigynum of the characteristic structure shown in the figures for the several species.

Generotype: *Masoncus arienus* new species.

Masoncus dux, new species

Fig. 103

Female.—Color: Carapace light brown. Chelicerae reddish brown. Endites orange brown. Sternum and labium light dusky brown. Legs and palpi yellowish brown. Abdomen black. Spinnerets dusky brown. Epigynum reddish brown and dusky.

Structure: Size a little above medium, moderately stout. Carapace broad oval. Head broad, rounded. Clypeus slightly protruding; height nearly 3 diameters of a. s. eye. Eye area occupying slightly more than half the width of the head. Posterior eye row procurved; p. m. eyes 1.2 diameters apart, 1.1 diameters from side eyes. Anterior row slightly recurved; a. m. eyes 0.3 diameter apart; 1.0 diameter from side eyes. Median ocular quadrangle a little longer than wide, a little wider behind than in front. Chelicerae vertical, stout; fang groove with five large teeth in front, two small teeth behind. Sternum broad, obtusely pointed behind, separating hind coxae by much less than a diameter. Legs moderately stout. Epigynum cavernous.

Measurements:

	♀	
	Mm.	*Ratio*
Length	2.25	188
Cephalothorax:		
Length	1.20	100
Width	0.95	79
Tibia-patella:		
1	1.07	89
4	....	....

Type locality.—MANITOBA: Churchill, June-July, 1936, ♀, H. E. McClure.

Masoncus arienus, new species

Figs. 99–102

Male, female.—Color: Carapace light brownish orange; eyes on black spots. Chelicerae light orange brown. Endites and labium yellowish orange. Sternum orange yellow. Legs and palpi light brownish yellow. Abdomen pale gray. Spinnerets pale yellow.

Structure: Size medium to large. Cephalic pits opening just back of the p. s. eye; the pits not extending under the p. m. eyes; head not otherwise modified. Height of clypeus about 2.7 diameters of an a. s. eye. Eye area occupies about 0.6 width of head. Posterior eye row slightly procurved; p. m. eyes about 0.9 diameter apart, 0.7 diameter from side eyes. Anterior row slightly procurved; a. m. eyes about 0.3 diameter apart, 0.4 diameter from side eyes. Median ocular quadrangle slightly wider than long, a little wider behind than in front.

Chelicerae vertical, moderately stout, slightly inflated especially near base; a spur on front toward distal end; fang groove with a small setigerous nodule in front, nine or ten teeth behind in two linear, and nearly consecutive, series, probably resulting from a migration of the anterior teeth to the rear. Endites with a small spur on ectal side of tip. Sternum large, convex; hind coxae separated by a little more than a diameter. Legs moderately long.

Palpus small. Patella normal. Tibia with two short, blunt, black processes on distal border above. Cymbium normal. Embolic division about as long as the tarsus, twisted but not coiled; tailpiece reduced in size.

Measurements:

	♂ Mm.	♂ Ratio	♀ Mm.	♀ Ratio
Length	2.25	225	2.65	273
Cephalothorax:				
Length	1.00	100	0.97	100
Width	0.80	80	0.75	77
Tibia-patella:				
1	1.00	100	0.95	98
4	....	....	....	....

Type locality.—ARIZONA: Covered Wells, January 3, 1941, ♂, D. and S. Mulaik.

Other records.—ARIZONA: 12 mi. W. Robes, January 2, 1941, 2 ♂ ♀, D. and S. Mulaik.

Masoncus nogales, new species

Figs. 93–98

Color: Carapace uniform orange yellow, with interocular area more or less dusky. Chelicerae light orange brown. Endites orange. Sternum orange yellow; labium darker. Legs and palpi yellow, with palpal organs of male darker. Abdomen pale gray. Spinnerets yellow. Epigynum brown and dusky.

Structure: Size a little above medium. General structure slightly elongate. Carapace elongate oval. Head slightly raised. Height of clypeus about 3 diameters of an a. s. eye. A short groove on each side of head, beginning between the posterior median and lateral eye; a small deep pit in the front end of the groove penetrating beneath p. m. eye. Head of female less elevated; height of clypeus 2 diameters of a. s. eye; head pits absent. Eye area occupying a little more than half the width of the head; a. m. eyes a little smaller than the others. Posterior row procurved; eyes 0.9 diameter apart. Anterior row procurved; eyes sub-contiguous. Lateral eyes of each side contiguous. Median ocular quadrangle about as wide as long; a little wider behind than in front. Chelicerae moderately stout, vertical, slightly convex in front; fang groove with six teeth in front, five behind; a small setigerous spur in front near distal end in male.

Sternum large, strongly convex; pointed behind, separating hind coxae by a scant diameter. Legs moderately long and slender. Male palpus small; embolic division short, with a spatulate tail-piece and with

two points distally, one partly curved around the other. Abdomen slightly elongate, pointed behind. Epigynum large and cavernous.

Measurements:

	♂ Mm.	♂ Ratio	♀ Mm.	♀ Ratio
Length	2.10	226	2 20	244
Cephalothorax:				
Length	0 93	100	0.90	100
Width	0.75	81	0 67	74
Tibia-patella:				
1	0.97	104	0.93	103
4	0 97	104	0.93	103

Type locality.—ARIZONA: 11 mi. No. Nogales, December 31, 1940, 2 ♂ 4 ♀ (♀ holotype, ♂ allotype, D. and S. Mulaik Colls.). One male has palpus stunted, the other has the bulbus separated. TEXAS: Water Valley, December, 1939, ♀, D. and S. Mulaik.

Genus **Minyriolus** Simon, 1884

Arachnides de France, 5: 656.

Generotype: *Minyriolus pusillus* (Wider).

Minyriolus (?) plesius, new species

Male, female.—Color: Carapace dark brown, lightly marked with dusky. Chelicerae and endites brown, lighter distally. Sternum and labium dark dusky brown. Legs and palpi yellowish brown, lightly shaded with dusky in female; palpal organs darker brownish and dusky. Abdomen black. Spinnerets light brown. Epigynum dusky brown.

Structure: Size medium. Body stout; legs moderately stout.

Male.—Carapace ovoid, wide behind, narrow in front; head only slightly elevated; with a distinct pit back of each p. s. eye. Clypeus vertical; height nearly 4 diameters of a. s. eye. Eye area occupies about 0.8 width of head; a. m. eye a little smaller than the others. Posterior eye row procurved; p. m. eye about 1.0 diameter apart, 1.5 diameters from side eye. Anterior row slightly procurved; a. m. eye about 0.5 diameter apart, 1.2 diameters from side eye. Median ocular quadrangle much longer than wide, wider behind than in front. Chelicerae vertical; a light-colored swelling on anterior mesal side, toward distal end. Sternum broad, separates hind coxae by slightly more than a diameter. Legs and abdomen normal. Both sets of stridulating organs present. Palpus moderately large; tibia with a long stout process; ambolus long, coiled, stout at base, slender at tip.

Female.—Similar to male; except, head not modified, legs stouter. Abdomen larger. Carapace ovoid, as in male, but head slightly wider. Clypeus slightly protruding; height about 2.5 diameters of a. s. eye. Eye area occupies about 0.7 width of head; a. m. eye smaller than the others. Posterior eye row slightly procurved; p. m. eye 1.0 diameter apart, 0.9 diameter from side eye. Anterior row faintly procurved; a. m. eye about 0.5 diameter apart, 0.6 diameter from side eye. Median ocular quadrangle longer than wide, wider behind. Chelicerae reclined; fang groove with four teeth in front, three behind. Epigynum small, consisting mainly of a simple convex plate, with openings at the sides, and through which a pair of long, slender tubes are visible.

Measurements:

	♂ Mm.	♂ Ratio	♀ Mm.	♀ Ratio
Length	1.75	219	1.90	224
Cephalothorax:				
Length	0.80	100	0.85	100
Width	0.70	88	0.70	82
Tibia-patella:				
1	0.75	94	0.75	88
4	0.80	100	0.82	96

Type locality.—WYOMING: Bridge Bay, Yellowstone Lake, June 20, 1938, ♂ 2 ♀.

Other record.—UTAH: Provo River at Cobble Rest Camp, July 30, 1936, 2 ♂, W. Ivie.

Minyriolus pampia, new species

Figs. 83–87

Male.—Color: Carapace brown, marked and shaded with blackish. Chelicerae dark brown. Sternum, labium and endites dark dusky brown. Legs and proximal segments of palpus light brownish yellow; distal part of palpus dusky brown. Abdomen black. Spinnerets brown.

Structure: Size moderately small. Carapace broad and rounded; head narrow, slightly elevated. Height of clypeus about 4 diameters of an a. s. eye. Eyes small. Posterior eye row slightly procurved; p. m. eyes 2.0 diameters apart, 2.5 diameters from side eyes. Anterior row about straight; a. m. eyes 1.0 diameter apart, 1.7 diameters from side eyes. Median ocular quadrangle decidedly longer than wide, wider behind than in front.

Chelicerae reclined. Sternum broad, separating hind coxae by about a length of one of them. Legs moderately short; tarsi 1 slightly inflated. Palpus moderately large. Tibia with a long dorsal process, with a bent tip. Embolus long and stout, with a semi-spiral tail-piece with a slender pointed process arising near the point of attachment and extending distally, and with a broad, flat attachment near the tip.

Measurements:

	♂ Mm.	♂ Ratio
Length	1 35	200
Cephalothorax:		
Length	0.68	100
Width	0.63	93
Tibia-patella:		
1	0.60	88
4	0.70	103

Type locality.—NORTHWEST TERRITORY, CANADA: River Clyde, Baffin Island, June 2, 1945, ♂, Jack P. Woolstenhulme.

Genus **Montilaira** Chamberlin, 1921

J. New York Ent. Soc., 29: 40.

Orthotype: *Montilaria uta* (Chamberlin).

Montilaria relicta, new species

Figs. 69–70

Female.—Color: Carapace yellowish brown, lightly shaded and marked with dusky. Chelicerae and endites orange. Sternum and labium dusky brown. Legs and palpi yellowish orange. Abdomen dark gray. Spinnerets orange.

Structure: Size large. Structure essentially normal. Eye area occupying more than two-thirds the width of the head. Eyes moderately small; a. m. eyes a little smaller than the others. Posterior eye row faintly recurved; p. m. eyes about 1.0 diameter apart, 0.7 diameter from side eyes. Anterior row straight; a. m. eyes 0.5 diameter apart, 0.5 diameter from side eyes. Height of clypeus about 2.5 of a. s. eye.

Chelicerae moderately stout; fang groove with five teeth in front, four teeth behind near base of fang, of which the mesal is the largest and the others tiny. Stridulating file prominent. Legs moderately long and stout. Epigynum simple; openings concealed from ventral view.

Measurements:

	♀ Mm.	Ratio
Length	2.50	236
Cephalothorax:		
Length	1.10	100
Width	0.80	73
Tibia-patella:		
1	1.20	109
4	1.25	114

Type locality.—VERMONT: Mt. Mansfield, June 14, 1927, ♀, R. V. Chamberlin.

Genus **Oedothorax** Bertkan, 1883

Verh. naturf. Ver. preus. Rheinlande u. Westfalens, 40: 228.

Generotype: *Oedothorax gibbosus.*

Oedothorax cascadeus, new species

Figs. 77, 78

Female.—Color: Carapace light brown, distinctly marked with dusky in the usual pattern; a blackish mark extending of a. m. eyes nearly to edge of clypeus. Chelicerae light brown. Endites light dusky brown. Sternum and labium dark dusky brown. Legs and palpi light brown. Abdomen dark gray. Spinnerets dusky brown. Epigynum dusky brown.

Structure: Size medium; body slightly elongate. Carapace essentially normal, slightly elongate. Height of clypeus about 2.5 diameters of a. s. eye. Eye area occupies about 0.7 width of head; a. m. eyes only a little smaller than the others. Posterior eye row straight; p. m. eyes 1.0 diameter apart, 0.9 diameter from side eyes. Anterior row straight; a. m. eyes 0.4 diameter apart, 0.4 diameter from side eyes. Median ocular quadrangle longer than wide, wider behind than in front.

Chelicerae vertical; fang groove with five teeth in front, five small teeth behind. Sternum normal, separates hind coxae by about a diameter. Legs normal length, moderately stout. Abdomen somewhat elongate. Epigynum moderately small; resembles epigynum of *O. trilobatus* in general appearance.

Measurements:

	♀ Mm.	♀ Ratio
Length	1.80	240
Cephalothorax:		
Length	0.75	100
Width	0.55	73
Tibia-patella:		
1	0.62	83
4	0.73	97

Type locality.—IDAHO: Cascade, July 5, 1943, ♀, W. Ivie.

Genus **Pselothorax**, new

Cephalothorax greatly elevated and shaped like a truncated cone; conspicuously depressed or pitted above, with a sharply impressed curved furrow in the depression setting off the head posteriorly, the head not otherwise definitely set off from the thorax. Posterior row of eyes slightly procurved, the anterior row straight, the two lateral eyes on each side contiguous. Bulb of male palpus with a well developed embolus which terminates at the distal end of the terminal lobe of the bulb; tibia very short, flaring in cup-like form, without apophysis. Abdomen high and proportionately short. Tibia of fourth legs lacking spines.

Orthotype: *Pselothorax atopus*, new species.

Pselothorax atopus, new species

Cephalothorax dusky over yellow; legs brownish yellow. Abdomen dusky brown, above marked with six pairs of transversely elongate light spots and two transverse light lines between the last pair of these and the spinnerets; spinnerets yellow; area in front of genital furrow enclosed by a light colored line; behind the furrow on each side a longitudinal light line.

Clypeus very high. Anterior median eyes separated by a diameter of one of them, or a little more, each contiguous or nearly so with the lateral eye. Posterior median eyes somewhat less than their diameter apart, each a little farther from the lateral. Length, 2.5 mm.

Type locality.—UTAH: Salt Lake County, at mouth of Red Butte Canyon. One male taken in sifting leaves by Kathleen Lafferty.

Genus **Sciastes** Crosby, 1938

Jour. New York Ent. Soc., 46: 75.

Orthotype: *Sciastes truncatus* (Emerton).

Sciastes tenna, new species

Fig. 79

Female.—Color: Carapace brown, with a pair of longitudinal lighter spots on back of head. Chelicerae and endites orange brown. Sternum

and labium light dusky brown. Legs and palpi orange brown. Abdomen dark gray. Spinnerets light orange. Epigynum dusky orange.

Structure: Size medium. Eyes protruding slightly over clypeus. Eyes occupying a little more than half the width of the head. Posterior eye row recurved. P. m. eyes about 1.0 diameter apart, 0.9 diameter from larger side eyes. Anterior row straight; a. m. eyes 0.4 diameter apart, 0.5 diameter from much larger side eyes. Median ocular quadrangle much wider behind than in front, about as wide behind as long. Height of clypeus about 3.0 diameters of an a. s. eye.

Chelicerae slightly reclined; fang groove with five teeth in front, three behind. Sternum separating hind coxae by a diameter of one of them. Palpus somewhat enlarged in the tibia and tarsus. Epigynum extended slightly behind, concealing single large opening beneath.

Measurements:

	♀ Mm.	Ratio
Length	1.85	195
Cephalothorax:		
Length	0.95	100
Width	0.75	79
Tibia-patella:		
1	0.75	79
4	0.77	81

Type locality.—TENNESSEE: Little Pegion Creek, Great Smoky Mts., July 9, 1933, W. Ivie.

Genus **Scironis** Crosby, 1938

Jour. New York Ent. Soc., 46: 72.

Orthotype: *Scironis tarsalis* (Emerton).

Scironis autor, new species

Fig. 104

Female.—Color: Carapace yellowish brown, with sides of head a little darker; eyes on small black spots. Chelicerae orange brown. Endites pale orange brown. Sternum and labium yellowish, lightly shaded with dusky. Legs and palpi light brownish orange. Abdomen pale yellowish gray. Spinnerets light yellowish. Epigynum yellowish, reddish brown, and dusky.

Structure: Size medium. Carapace moderately large, head slightly large, rounded, highest near middle; median groove absent. Clypeus light, smooth, slightly protruding; height about 4 diameters of a. s. eye. Eyes small; eye area occupies between 0.6 and 0.7 width of head. Posterior eye row slightly recurved; p. m. eyes about 2.0 diameters apart, 2.6 diameters from s. e. Anterior row slightly recurved; a. m. eyes about 0.5 diameter apart, 2.0 diameters from the side eyes. Median ocular quadrangle slightly wider than long, wider behind than in front.

Chelicerae vertical, moderately stout; stridulating file weak, but distinct, fang groove with five teeth in front, four small teeth behind. Sternum normal, separates hind coxae by about a diameter. Legs long. Abdomen normal; epigastric plates with a weak stridulating file.

Epigynum with a broad transverse lobe, hollowed out in middle and front, as usual; anterior pits absent.

Measurements:

	♀ Mm.	Ratio
Length	1.95	209
Cephalothorax:		
Length	0.93	100
Width	0.70	75
Tibia-patella:		
1	0.95	102
4	1.00	107

Type locality.—CALIFORNIA: Guernsey Cr., Sept. 7, 1935, ♀, R. V. Chamberlin and W. Ivie.

Scironis sima, new species

Figs. 105, 106

Male.—Color: Carapace light brownish yellow; eyes narrowly ringed with black. Chelicerae light orange brown. Endites, sternum, legs and palpi light yellowish; palpal organs darker. Labium light dusky yellow. Abdomen pale grayish yellow. Spinnerets light yellowish.

Structure: Size medium to small. Carapace essentially normal, head not modified, rounded; median groove absent. Clypeus slightly protruding; height about 4 diameters a. s. eye. Eyes small; eye area occupies about 0.5 width of head. Posterior eye row slightly procurved; p. m. eye about 1.5 diameters apart, 1.0 diameter from side eyes. Anterior row straight; a. m. eyes about 0.5 diameter apart, 0.8 diameter from side eyes. Median ocular quadrangle wider than long, much wider behind than in front.

Chelicerae vertical, normal; ectal side smooth, stridulating file apparently absent; fang groove with four teeth in front. Sternum moderately large, convex; separates hind coxae by 1.5 diameters. Legs moderately weak. Abdomen normal. Femur normal. Patella normal, a little longer than wide. Tibia wider than long, spread out distally with a conical process on dorsal rim. Tarsus enlarged, somewhat bell-shaped. Paracymbium moderately large, strongly hooked. Embolus long and coiled, making about one and a half large turns, stout at base, very slender distally; tail piece short, slightly curved in same direction as base of embolus, with a long, white, lash-like lamella.

Measurements:

	♂ Mm.	Ratio
Length	1.60	229
Cephalothorax:		
Length	0.70	100
Width	0.56	80
Tibia-patella:		
1	0.70	100
4	0.76	108

Type locality.—OREGON: Comstock, Sept. 9, 1935, ♂, R. V. Chamberlin and W. Ivie.

Genus Scylaceus Crosby, 1938

Jour. New York Ent. Soc., 46: 91.

Orthotype: *Scylaceus pallidus* (Emerton).

Scylaceus divisus, new species

Fig. 108

Female.—Color: Carapace yellowish, very lightly marked with dusky; eyes on black spots. Chelicerae yellowish brown. Endites light yellow. Sternum and labium yellow, shaded with dusky. Palpi and legs light yellow. Abdomen pale gray, shaded around spinnerets. Spinnerets pale yellow. Epigynum pale yellow, light brownish and dusky.

Structure: Size medium to small. Carapace normal. Clypeus slightly protruding; height a 3 diameters of a. s. eye. Eye area occupies about 0.6 width of head; a. m. eye much smaller than the others. Posterior eye row slightly recurved; p. m. eye 0.9 diameter apart, 0.7 diameter from side eye. Median ocular quadrangle slightly wider than long, much wider behind.

Chelicerae slightly reclined; stridulating file distinct; fang groove with five large teeth in front, five small teeth behind. Sternum normal. Legs moderately slender. Abdomen with stridulating files on epigastric plates. Epigynum with a large cross-piece behind, grooved along the middle and containing a small lobe in the posterior end of the groove; a large anterior lobe extending posteriorly.

Measurements:

	♀ Mm.	Ratio
Length	1.50	200
Cephalothorax:		
Length	0.75	100
Width	0.60	80
Tibia-patella:		
1	0.78	104
4	0.84	112

Type locality.—North Dakota: Divide Co., 1936–1938, ♀, Joe Davis.

Scylaceus amylus, new species

Fig. 107

Female.—Color: Carapace brownish-yellow; eyes on black spots. Chelicerae light brown. Endites light brownish orange. Sternum and labium yellowish, highly shaded with dusky. Abdomen pale gray, shaded with darker gray on dorsum, venter, and around spinnerets. Spinnerets yellowish. Epigynum yellowish, brownish and dusky.

Structure: Size small. Carapace normal; convex back of the eyes; without median groove. Clypeus slightly protruding; height about 2.2 diameters of a. s. eye. Eye area occupies about 0.5 width of head; a. m. eye much smaller than the others. Posterior eye row straight; p. m. eye 0.9 diameter apart, 0.6 diameter from side eye. Anterior row straight; eye subcontiguous. Median ocular quadrangle longer than wide, much wider behind than in front.

Chelicerae vertical; fang groove with four large teeth in front. Sternum moderately large; separates hind coxae by a little more than one diameter. Legs moderately short. Epigynum large, with a distinct rectangular cross piece behind and an obscure median septum.

Measurements:

	♀ *Mm.*	*Ratio*
Length	1.24	218
Cephalothorax:		
Length	0.57	100
Width	0.45	79
Tibia-patella:		
1	0.42	74
4	0.47	82

Type locality.—OHIO: Sugar Grove, August 3, 1935, ♀, Barrows and Ivie.

This species closely resembles *pallidus* in size, color, and structure, but differs considerably in the details of the epigynum.

Scylaceus pallas, new species

Female.—Color: Carapace, legs, palpi, sternum, labium, endites and spinnerets pale yellowish. Chelicerae brownish yellow. Abdomen pale grayish white. Epigynum yellowish brownish and dusky.

Structure: Size very small. Carapace normal, slightly elongate; without median groove. Clypeus slightly protruding; height about 2.0 diameters of a. s. eye. Eye area occupies between 0.6 and 0.7 width of head; a. m. eye much smaller than the others. Posterior eye row about straight, very slightly procurved; p. m. eye about 1.2 diameters apart, 0.8 diameter from side eye. Anterior row slightly recurved; a. m. eye about 0.4 diameter apart, 0.8 diameter from side eyes. Median ocular quadrangle about as wide as long, much wider behind.

Chelicerae vertical. Sternum large; hind coxae separated by more than a diameter. Legs with tarsi nearly as long as metatarsi. Epigynum with a small cross-piece behind, and with a long, rounded median ridge forming an inverted T with it; spermathecae and tubes conspicuous.

Measurements:

	♀ *Mm.*	*Ratio*
Length	1.00	208
Cephalothorax:		
Length	0.48	100
Width	0.36	75
Tibia-patella:		
1	0.37	77
4	....	....

Type locality.—ILLINOIS: Pallas Park, October 19, 1941, ♀, R. Wenzel.

This species is smaller and lighter in color than *pallidus*. It is more slender in the body, and there are minor differences in the eyes and epigynum.

Genus **Spirembolus** Chamberlin, 1920

Canad. Ent., 52: 197.

Orthotype: *Spirembolus monticolens* (Chamberlin).

Spirembolus cheronus, new species

Figs. 109, 110

Female.—Color: Carapace yellowish brown, lightly marked with dusky; interocular area largely black. Chelicerae and endites yellowish brown. Sternum and labium dusky over yellowish brown. Legs and palpi yellowish brown, end of femora ringed with dusky. Abdomen blackish. Spinnerets light brown. Epigynum dusky brown.

Structure: Size medium to small. Carapace normal, median groove absent. Clypeus vertical; height about 2.0 diameters of a. s. eye. Eye area occupies about 0.6 width of head; a. m. eyes smaller than the others. Posterior eye row straight; p. m. eyes about 1.0 diameter apart, about 0.9 diameter from side eye. Anterior row straight; a. m. eyes about 0.5 diameter apart, 0.6 diameter from side eye. Median ocular quadrangle slightly longer than wide; wider behind than in front.

Chelicerae vertical, stout; fang groove with five teeth in front; stridulating file present. Sternum normal; separates hind coxae by about a diameter. Legs moderately short; leg 4 much longer than leg 1. Epigynum simple; from ventral view, there is a pair of broad lateral lobes, raised at posterior edge, and narrowly separated in the middle, exposing the posterior sclerite, from posterior view, the lateral lobes each have a large opening on the posterior-mesal side, and the posterior sclerite is moderately small, somewhat longitudinally rectangular with rounded corners.

Measurements:

	♀ Mm.	♀ Ratio
Length	1.95	222
Cephalothorax:		
Length	0.88	100
Width	0.65	74
Tibia-patella:		
1	0.64	73
4	0.75	83

Type locality.—Wyoming: Thumb, Yellowstone Park, June 23, 1938, ♀, W. Ivie.

Spirembolus oreinoides, new species

Fig. 41

Female.—Color: Carapace light brown, faintly marked with dusky. Chelicerae and endites light brown with pale tips. Sternum and labium dark dusky brown. Legs and palpi yellowish brown. Abdomen dark gray. Spinnerets light brownish yellow. Epigynum yellowish brown and dusky brown.

Structure: Size medium. General structure moderately robust. Carapace normal; head smoothly rounded except for the eyes. Height of clypeus about 3.5 diameters of a. s. eye at position of lateral eyes.

Eyes small; a. s. eyes slightly larger than the others. Eye area occupies about 0.6 width of head. Posterior eye faintly procurved; p. m. eyes 1.3 diameters apart, 1.2 diameters from side eyes. Anterior slightly recurved; a. m. eyes 0.3 diameter apart, 1.5 diameters from side eyes. Median ocular quadrangle about as long as wide, much wider behind than in front.

Chelicerae vertical; fang groove with five teeth in front (including a small nodule near base of fang) and five small teeth behind. Legs, sternum and abdomen normal. Epigynum of medium size.

Measurements:

	♀ *Mm.*	*Ratio*
Length	2.30	219
Cephalothorax:		
Length	1.05	100
Width	0.78	74
Tibia-patella:		
1	1.00	95
4	1.12	107

Type locality.—CALIFORNIA: Summit Mt. Palomar, July 26, 1931, ♀, R. V. Chamberlin and W. Ivie.

Spirembolus maderus, new species

Fig. 111

Female.—Color: Carapace yellowish brown, marked with dusky in the usual pattern; interocular area blackish. Chelicerae and endites light brown, lighter at the tips. Sternum and labium dusky over yellow. Legs and palpi yellowish brown, lighter at the joints. Abdomen dark gray. Spinnerets light brownish yellow. Epigynum brownish yellow and dusky.

Structure: Size small to medium. Carapace normal; dorsal profile slightly undulating. Clypeus slightly protruding; height a 3.0 diameter of a. s. eye. Eye area occupies a 0.6 width of head; a. m. eye a little smaller than the others. Posterior eye row straight; p. m. eye about 1.2 diameters apart, 0.8 diameters from side eye. Anterior row slightly procurved; a. m. eye about 0.3 diameter apart, 1.0 diameter from the side eye. Median ocular quadrangle about as long as wide, wider behind.

Chelicerae about vertical; stridulating file present; fang groove with five large teeth in front, five small teeth behind; a row of three small setigerous tubercles along mesal edge of each chelicerae in front. Sternum moderately large; separates hind coxae by about a diameter. Epigastric plates with a fine, but distinct, stridulating file; a distinct pick on coxae 4. Epigynum of the usual form.

Measurements:

	♀ *Mm.*	*Ratio*
Length	1.70	205
Cephalothorax:		
Length	0.83	100
Width	0.58	70
Tibia-patella:		
1	0.70	84
4	0.80	96

Type locality.—ARIZONA: Madera Canyon, Santa Rita Mts., September 8, 1941, ♀, W. Ivie.

Other records.—CALIFORNIA: Henshaw Dam, July 25, 1931, ♀, Chamberlin and Ivie; Irvine Park, near Santa Ana, July 17, 1931, ♀, Chamberlin and Ivie.

This may be the female of *S. spiratulus* (Banks).

Spirembolus orthus, new species

Fig. 112

Female.—Color: Carapace yellowish brown, lightly marked with dusky in the usual pattern. Chelicerae light brown. Endites pale brownish. Sternum and labium dusky over yellow. Legs and palpi light brown. Abdomen medium gray. Spinnerets light brown. Epigynum brownish yellow and dark brown.

Structure: Size small. Carapace normal; dorsal profile smooth. Clypeus slightly protruding; height about 2.5 diameters of a. s. eye. Eye area occupies about 0.6 width of head; a. m. eyes a little smaller than the others. Posterior eye row straight; p. m. eye about 1.0 diameter apart, 0.7 diameter from side eye. Anterior row straight, faintly procurved; a. m. eye about 0.3 diameter apart, 0.6 diameter from side eye. Median ocular quadrangle about as wide as long, wider behind than in front.

Abdomen with stridulating file on epigastric plates. Epigynum moderately small; with conspicuous spermathecae and with the usual cross-piece behind, which is extended forward in the middle as a short blunt septum.

Measurements:

	♀ Mm.	♀ Ratio
Length	1.65	236
Cephalothorax:		
Length	0.70	100
Width	0.55	79
Tibia-patella:		
1	0.60	86
4	0.67	96

Type locality.—CALIFORNIA: W. side Owens Lake, August 6, 1931, ♀, W. Ivie.

This species closely resembles *S. whitneyana* Chamberlin and Ivie. The color appears to be a little lighter and the epigynum shows minor differences; principally, the median septum is more distinct and the lateral arms of the cross-piece, seen from ventral view, are a little longer and more slender.

Genus **Tachygyna** Chamberlin and Ivie, 1939

VII Intern. Kongress für Ent., p. 61.

Orthotype: *Tachygyna vancouverana* Chamberlin and Ivie.

Tachygyna paita, new species

Figs. 135, 136

Male.—Color: Carapace yellowish brown, marked with dusky in the usual pattern; interocular area dusky. Chelicerae brown, lighter

at distal end. Endites light dusky brown with light tips. Sternum and labium dark dusky over yellow. Legs and palpi light yellowish, palpal organs darker. Abdomen dark gray. Spinnerets light yellowish.

Structure: Size small. Carapace normal. Clypeus slightly protruding; height a 2.5 diameter of a. s. eye. A. m. eyes much smaller than the others; eye area occupies about 0.6 width of head. Posterior eye row faintly procurved; p. m. eye about 0.7 diameter apart, 0.6 diameter from side eye. Anterior row straight; a. m. eye about 0.3 diameter apart, 0.6 diameter from side eye. Median ocular quadrangle slightly longer than wide, wider behind than in front.

Chelicerae vertical, normal. Sternum large, convex, truncate behind; separates hind coxae by more than a diameter. Legs moderately short. Palpus of medium size; dorsal rim of tibia only slightly modified. Cymbium not modified. Paracymbium normal, moderately large. Embolic division with a short, broad, flat tail-piece; with a short spur at base of embolus; embolus curved in a half circle.

Length, 1.36 mm. Length of cephalothorax, 0.62 mm.; width, 0.49 mm.; tibia-patella 1, 0.47 mm.; tibia-patella 4, 0.53 mm.

Type locality.—UTAH: Mirror Lake, Uintah Mts., August 18, 1942, ♂ holotype, (W. Ivie coll.).

Tachygyna sima, new species

Figs. 137, 138

Female.—Color: Carapace light brown, conspicuously marked with dusky; eyes on black spots which are connected together. Chelicerae light brown, paler distally. Endites dusky brown with light tips. Legs and palpi pale brown, with the joints narrowly shaded. Abdomen blackish. Spinnerets light brown. Epigynum brown, shaded with dusky.

Structure: Size small. Carapace essentially normal; median groove present. Clypeus slightly protruding; height 1.8 diameters of a. s. eye. A. m. eyes much smaller than the others, which are large; eye area occupies about 0.8 width of head. Posterior eye row straight; p. m. eye about 0.8 diameter apart, 0.5 diameter from side eye. Anterior row straight; a. m. eye about 0.8 diameter apart, 0.9 diameter from side eye. Median ocular quadrangle about as wide as long, wider behind than in front.

Chelicerae vertical; stridulating file present. Sternum large, truncate behind; separates hind coxae by more than a diameter. Legs, palpi and abdomen normal. Epigynum large and rather long.

Length, 1.35 mm. Length of cephalothorax, 0.66 mm.; width, 0.50 mm. Length of tibia-patella 1, 0.56 mm.; tibia-patella 4, 0.62 mm.

Type locality.—BRITISH COLUMBIA: Vancouver Id., Sidney, ♀ holotype taken by R. V. Chamberlin and W. Ivie, Sept. 10, 1935.

Tachygyna watona, new species

Figs. 133, 134

Female.—Color: Carapace light yellowish brown, lateral margins lightly shaded; eyes on black spots. Chelicerae and endites yellowish brown. Sternum and labium dusky yellow. Legs and palpi light

yellowish brown; the distal end of coxae shaded on ventral side. Abdomen light gray. Spinnerets light brownish yellow. Epigynum brownish.

Structure: Size small. Carapace normal. Clypeus slightly protruding; height a 2.0 diameters of a. s. eye. Eye area occupies about 0.6 width of head; a. m. eye much smaller than the others. Posterior eye row procurved; p. m. eye about 1.1 diameters apart, 1.0 diameter from side eye. Anterior row faintly recurved; a. m. eye about 0.7 diameter apart, 0.9 diameter from side. Median ocular quadrangle longer than wide, wider behind than in front.

Chelicerae moderately short, slightly reclined. Sternum large; separates hind coxae by more than a diameter. Legs moderately short; tarsi 1 and 2 nearly as long as metatarsi. Abdomen normal. Epigynum typical, with minor variations.

Length 1.4 mm. Length of cephalothorax, 0.64 mm.; width, 0.50 mm. Length of tibia-patella 1, 0.50 mm.; of tibia-patella 4, 0.57 mm.

Type locality.—UTAH: Mirror Lake, Uintah Mts., Oct. 15, 1939, ♀ holotype.

Genus **Tapinocyba** Simon, 1884

Arachnides de France, 5: 778.

Generotype: *Topincyba praecox* Cambridge.

Tapinocyba alpha, new species

Figs. 154, 155, 156

Carapace with ground color a pale grayish tan, with pars thoracica dusky and the lateral margins black; on the caudal part of the head a shield-shaped dusky area from the front of which three dark lines run forward, the middle one of these extending only part way to the eyes and the lateral ones reaching to or nearly to the lateral eye on each side behind which there is a well defined dark dot. Legs clear pale yellow. Sternum of same color as carapace, dusky throughout. Endites clear yellow. Abdomen dusky or nearly black throughout. Spinnerets pale.

Posterior row of eyes recurved, the medians not fully their diameter apart and slightly closer to the laterals. Quadrangle of median eyes much narrower in front than behind. Anterior row of eyes straight, the eyes contiguous, the medians notably smaller than the laterals, the black area on which they stand extending some distance down on clypeus. Furrow of chelicerae with three large teeth on anterior margin and two small ones on posterior margin.

Epigynum as shown in fig. 154, and the features of the male palpus as shown in figs. 155 and 156.

Length, 1 mm.

Type locality.—UTAH: Salt Lake City, Dry Creek Canyon, ♂♂, 1 ♀, Oct. 22 and 30, 1932. Also paratype, summer of 1933.

Tapinocyba (?) gamma, new species

Fig. 153

Carapace yellow, with a shield-shaped area outlined in black and bisected by a longitudinal median black line, a line extending forward

from each anterior corner to a posterior lateral eye and a fine median line running forward to a point between the posterior median eyes; carapace also dusky on lower sides, especially along margins. Legs clear yellow. The rather strongly convex sternum dusky over yellow. Endites yellow. Labium dusky across anterior border. Abdomen solid black throughout but the spinnerets yellow.

Posterior row of eyes a little procurved; median about their diameter apart, obviously nearer to the laterals. Anterior row of eyes straight, the eyes nearly contiguous, with the medians notably smaller than the laterals. Anterior margin of furrow of chelicera with three relatively large and well spaced teeth; the posterior margins with fine small teeth in a close series.

Epigynum as shown in fig. 153.

Length, 1.3 mm.

Type locality.—UTAH: Uintah Mts., Mirror Lake, several ♀ ♀ taken July 28, 1936, by W. Ivie.

Tapinocyba idahoana, new species

Figs. 129, 130

Female.—Color: Carapace dark dusky brown. Chelicerae light brown. Labium and sternum dark dusky brown; endites a little lighter. Legs and palpi light brown. Abdomen dense black. Spinnerets dusky brown. Epigynum dusky brown.

Structure: Size small. General structure short and broad; legs short. Carapace broad; head narrowed; clypeus rounded across front. Chelicerae very slightly protruding; height about 2.5 diameters of a. s. eye. Eye area occupies about 0.7 width of head; eyes a little above average in size; a. m. eyes smaller than the others. Posterior eye row faintly procurved; p. m. eyes about 1.0 diameter apart, about 0.8 diameter from side eyes. Anterior row straight; a. m. eyes 0.5 diameter apart, 0.6 diameter from side eyes. Median ocular quadrangle longer than wide, wider behind than in front.

Chelicerae slightly reclined; fang groove with four teeth in front, four small teeth behind. Sternum a little wider than long; broadly truncate behind, separating the hind coxae by a full length of one of them. Legs short. Abdomen moderately wide. Epigynum consists of a short, flattened lobe extending posteriorly, with the tip split at the middle; with a small cavity near middle of ventral side, which contains the openings; and with a wide, rounded dorsal plate, concealed with the tip divided in the middle for a short distance.

Measurements:

	♀ Mm.	Ratio
Length	1.45	234
Cephalothorax:		
Length	0.62	100
Width	0.56	90
Tibia-patella:		
1	0.48	77
4	0.55	89

Type locality.—IDAHO: 2 mi. N. E. Fruitland, June 30, 1943, ♀, W. Ivie.

Tapinocyba iowa new species

Figs. 124, 125

Female.—Color: Carapace light brownish yellow, shaded with dusky on the lateral margins and with black rings around the eyes. Chelicerae and endites orange. Sternum and labium dusky yellow. Legs and palpi light yellow, with end of coxae narrowly margined with black. Abdomen dark gray. Spinnerets light brown.

Structure: Size small; slightly elongate. Eye area occupying three-fourths width of head. Anterior median eyes a little smaller than the others. Posterior row about straight; p. m. eyes 0.9 diameter apart, 0.6 diameter from side eyes. Anterior row straight; a. m. eyes 0.3 diameter apart, 0.4 diameter from side eyes. Height of clypeus 1.7 diameter of a. s. eye. Median ocular quadrangle wider behind than in front, about as wide as long. Chelicerae vertical; fang groove with five very small teeth in front and four denticles behind. Legs moderately long. Epigynum small, flat; with a pair of small openings on the dorsal side of the tip.

Measurements:

	♀ Mm.	Ratio
Length	1.30	232
Cephalothorax:		
Length	0.56	100
Width	0.40	71
Tibia-patella:		
1	0.56	100
4	0.60	107

Type locality.—IOWA: Washington Co., 1935, ♀, Floyd Andre.

Tapinocyba kesimba, new species

Figs. 117–121

Male, female.—Color: Carapace pale brownish-yellowish, sometimes lightly marked with dusky; eyes on black spots. Chelicerae light orange brown. Endites pale orange. Sternum and labium yellowish, more or less shaded with dusky. Palpi and legs yellowish. Abdomen pale or medium gray. Spinnerets yellowish, sometimes lightly shaded with dusky. Epigynum yellowish brown and dusky.

Structure: Size small. Carapace oval; head of male slightly elevated with posterior rise abrupt; head of female normal. Eye area occupies about 0.6 width of head. Clypeus high, slightly protruding; height about 3.0 diameters of a. s. eye in male, about 2.2 diameters in female. Eyes of medium size; a. m. much smaller than a. s., p. m. smaller than p. s. Posterior row slightly recurved; p. m. eyes about 1.0 diameter apart, about 0.6 diameter from side eyes. Anterior row straight; a. m. eyes 0.4 diameter apart, 0.6 diameter from side eyes. Median ocular quadrangle barely wider than long, wider behind than in front.

Chelicerae vertical; fang groove with four small teeth in front, two tiny teeth behind. Legs moderately small and slender, sternum normal. Male palpus with a moderately long, pointed dorsal process and with a single stout spine near base above; paracymbium slender and

strongly hooked; embolic division with a tooth-shaped tail-piece, a heavy middle section, and two curved thin, flattened terminal processes; the latter protected by a broad flat lamella. Epigynum with a large posterior plate, which is deeply cleft medially in front, and through which two comma-shaped dark spots appear; with an anterior lip-like process partly overlapping broad cavity.

Measurements:

	♂ Mm.	♂ Ratio	♀ Mm.	♀ Ratio
Length	1.50	250	1.40	233
Cephalothorax:				
Length	0.60	100	0.60	100
Width	0.45	75	0.45	75
Tibia-patella:				
1	0.56	93	0.50	83
4	0.62	103	0.53	88

Type locality.—ARIZONA: Kaibab Forest (V. T. Ranch), September 4, 1931, 2♂, 6♀, R. V. Chamberlin.

Other records.—ARIZONA: Kaibab Forest, September 4, 1931, 2♂, 6♀, R. V. Chamberlin. UTAH: Henry Mts., Sept. 9, 1929, ♂, 5♀, R. V. Chamberlin and W. J. Gertsch; Fish Lake, Sept. 4, 1929, 4♀, R. V. Chamberlin and W. J. Gertsch; Strawberry Res., Sept. 2, 1928, ♀, R. V. Chamberlin.

Tapinocyba (?) phana, new species

Fig. 126

Female.—*Color:* Carapace light yellowish-brown, lightly marked with dusky, and with side margins and interocular area blackish. Chelicerae light orange brown. Endites pale yellowish, lightly marked with dusky. Sternum and labium dark dusky over yellow. Legs and palpi light yellowish. Abdomen dark gray. Spinnerets dusky yellow.

Structure: Size small; body slightly elongate. Carapace narrow; clypeus rounded across front; slightly humped back of eyes. Eye area occupies about 0.6 width of head. Posterior eye row recurved; p. m. eyes 1.0 diameter apart, 0.5 diameter from side eyes. Anterior row slightly procurved; a. m. eyes 0.3 diameter apart, 0.3 diameter from the larger side eyes. Median ocular quadrangle a little wider than long, wider behind than in front. Chelicerae about vertical; fang groove with three small teeth in front, two small teeth behind. Sternum large, convex; truncate posterior end separates hind coxae by more than a diameter. Abdomen slightly elongate. Epigynum covered with a large, transversely oval, clear plate, two large spermathecae in front of the ectal corners.

Measurements:

	♀ Mm.	♀ Ratio
Length	1.52	241
Cephalothorax:		
Length	0.63	100
Width	0.41	65
Tibia-patella:		
1	0.58	92
4	0.60	95

Type locality.—IDAHO: 4 mi. N. E. McCall, October 18, 1944, ♀.

Tapinocyba (?) pontis, new species

Figs. 127, 128

Female.—Color: Carapace light brownish yellow, lightly marked with dusky; eyes on black spots. Chelicerae and endites orange brown. Sternum and labium dusky. Legs and palpi light yellowish. Abdomen light to medium gray. Spinnerets yellowish. Epigynum yellowish and dusky.

Structure: Size small, body slightly elongate. Carapace ovoid, head moderately broad, slightly convex back of the eyes. Height of clypeus about 2 diameters of an a. s. eye. Eye area occupies about 0.6 width of head. A. m. eyes much smaller than the others. Posterior eye row procurved; p. m. eyes about a diameter apart, about 0.7 diameter from side eyes. Anterior row faintly recurved; a. m. eyes about 0.3 diameter apart, about 0.5 diameter from side eyes. Median ocular quadrangle longer than wide, wider behind than in front.

Chelicerae slightly reclined, moderately short; fang groove with four teeth in front, five teeth behind. Sternum normal; separates hind coxae by about a diameter. Legs normal. Epigynum simple, with a large opening posteriorly which is mostly filled by the rounded posterior sclerite.

Measurements:

	♀ Mm.	Ratio
Length	1.35	208
Cephalothorax:		
Length	0.65	100
Width	0.49	75
Tibia-patella:		
1	0.50	77
4	0.57	88

Type locality.—WYOMING: Bridge Bay, Yellowstone Lake, August 11, 1940, 2 ♀.

Tapinocyba sucra, new species

Figs. 122, 123

Female.—Color: Carapace brown, lightly marked with dusky. Chelicerae and endites orange brown. Sternum and labium dusky brown. Legs and palpi yellowish. Abdomen dark gray. Spinnerets yellowish. Epigynum dusky brown.

Structure: Size small. Carapace essentially normal; clypeus slightly protruding; head slightly elevated back of the eyes, height of clypeus about 2 diameters of an a. s. eye. Eye area occupying most of the width of the head. A. m. eyes much smaller than the others. Posterior row slightly procurved; p. m. eyes about 1.1 diameters apart, about 0.9 diameters from side eyes. A. m. eyes about 0.7 diameter apart, 1.0 diameter from the side eyes. Median ocular quadrangle wider behind than in front, about as wide behind as long. Chelicerae reclined. Epigynum simple, with two small round openings.

Measurements:

	♀ Mm.	Ratio
Length	1.30	217
Cephalothorax:		
Length	0.60	100
Width	0.48	80
Tibia-patella:		
1	0.45	75
4	0.48	80

Type locality.—OHIO: Sugar Grove, Aug. 17, 1935, W. Ivie and W. M. Barrows.

Tapinocyba (?) **vermontis,** new species

Fig. 152

Female.—Color: Carapace yellowish brown, lightly shaded with dusky; space between the eyes blackish. Chelicerae and endites orange. Sternum and labium dusky brown punctate with small white dots. Palpi and legs yellow, legs more or less shaded at the proximal joints. Abdomen light gray. Spinnerets orange. Epigynum dusky brown.

Structure: Size small. Structure essentially normal. Eye area occupying nearly two-thirds of head. A. m. eyes much smaller than the others. Posterior eye row slightly procurved; p. m. eyes about a diameter apart, about a radius from the side eyes. Posterior row straight; eyes sub-contiguous. Median ocular quadrangle more than twice as wide behind as in front. Height of clypeus 2 diameters of an a. s. eye. Epigynum a flattened plate, with a W-shaped dusky pattern showing through.

Measurements:

	♀ Mm.	Ratio
Length	1.20	200
Cephalothorax:		
Length	0.60	100
Width	0.44	73
Tibia-patella:		
1	0.50	83
4	0.55	92

Type locality.—VERMONT: Jamaica, July 11, 1913, ♀, R. V. Chamberlin.

Genus **Tigellinus** Simon, 1884

Arachnides de France, 5: 838.

Generotype: *Tigellinus furcillatus* (Menge).

Tigellinus (?) **perditus,** new species

Fig. 131

Female.—Color: Carapace brown. Chelicerae and endites light reddish brown with lighter tips. Sternum brown, slightly dusky at the margins; labium dusky brown. Legs and palpi yellowish brown. Abdomen dark gray. Spinnerets yellow. Epigynum reddish brown.

Structure: Size medium; body somewhat elongate; legs moderately short. Carapace normal, slightly elongate, head narrowed. Height

of clypeus a little more than 2 diameters of an a. s. eye. Eye area occupies about two-thirds width of head. Eyes about equal. Posterior eye row straight; p. m. eyes about 1.0 diameter apart, 0.8 diameter from side eyes. Anterior row straight; a. m. eyes 0.2 or 0.3 diameter apart, 0.5 to 0.6 diameter from the side eyes. Median ocular quadrangle slightly longer than wide, wider behind than in front. Chelicerae vertical; fang groove without teeth on its margins. Sternum large, separates hind coxae by a little more than a diameter. Legs moderately short. Abdomen large, elongate, oval. Epigynum consists of a large, somewhat quadrangular, shiny, elongate plate.

Measurements:

	♀ *Mm.*	*Ratio*
Length	2.00	267
Cephalothorax:		
Length	0.75	100
Width	0.58	77
Tibia-patella:		
1	0.68	90
4	0.80	107

Type locality.—Uncertain, no data, probably vicinity of Salt Lake City, Utah, 2 ♀.

Tigellinus mesus, new species

Fig. 132

Female.—Carapace dark brown, inconspicuously marked with dusky. Chelicerae and endites dusky brown. Sternum and labium brownish black. Palpi and legs brownish orange, with the tibiae of legs 1 and 2 and tibia and tarsus of palpus blackish brown; tibia 3 and 4 shaded, but lighter than 1 and 2. Abdomen shiny black. Spinnerets and epigynum dusky brown.

Side medium. Carapace ovoid; head narrow and slightly elevated. Height of clypeus about 3.5 diameters of an a. s. eye. Eye area occupies about two-thirds the width of the head; eyes sub-equal. Posterior eye row slightly procurved; p. m. eyes about 0.9 diameter apart, same distance from side eyes. Anterior row straight; a. m. eyes about 0.5 diameter apart, same distance from larger side eyes. Median ocular quadrangle much longer than wide, a little wider behind than in front. Chelicerae vertical. Sternum normal; hind coxae separated by about a diameter. Legs moderately large. Abdomen broad. Epigynum with a large posterior plate, appearing as a transverse bar in ventral view, in front of which is a transverse opening.

Measurements:

	♀ *Mm.*	*Ratio*
Length	2.50	250
Cephalothorax:		
Length	1.00	100
Width	0.72	72
Tibia-patella:		
1	0.95	95
4	1.07	107

Type locality.—COLORADO: Pikes Peak (11,600 ft.), June 22, 1940, ♀, W. Ivie.

Tigellinus weber, new species

Fig. 160

Carapace dusky chestnut. Legs light orange yellow. Sternum dusky chestnut. Endites orange. Abdomen black above and over the sides, the venter grayish black except in front of the furrow where the color is yellow.

Posterior row of eyes procurved, eyes subequal, or the medians a little larger; medians a little more than their diameter apart. Quadrangle of median eyes longer than wide, narrower in front than behind. Anterior lateral eyes larger than the posterior laterals. Anterior row of eyes a little recurved; median eyes smaller than the laterals, subcontiguous with each other, about their radius from the laterals. Anterior margin of furrow of chelicera with four teeth which decrease gradually in height to the most distal one; posterior margin with a single tooth.

Epigynum as shown in fig. 160.

Length,

Type locality.—UTAH: Smith and Morehouse branch of the Weber Canyon, ♀ holotype taken October 7, 1932, by R. V. Chamberlin.

Genus **Tortembolus** Crosby

Proc. Calif. Acad. Sci., 14: 115.

Orthotype: *Tortembolus tortuosus* Crosby.

Tortembolus approximatus, new species

Figs. 140–144

Male, female.—Color: Carapace light yellowish brown, sometimes lightly marked with dusky; eyes on black spots. Chelicerae light brown. Endites light orange brown. Sternum and labium dusky over yellow to dark dusky. Legs and palpi yellow or light brownish; palpal organs brownish and dusky. Abdomen dark gray; epigastric area pale. Spinnerets light brownish yellow. Epigynum pale yellow and light dusky.

Female.—Structure: Size medium. Carapace moderately large, slightly elongate; median groove absent; head slightly humped back of eyes. Clypeus protruding; height about 3.0 diameters of a. s. eye. Eyes small, imperfect; eye area occupies about 0.6 width of head. Posterior eye row faintly recurved; p. m. eye about 1.6 diameters apart, 1.6 diameters from side eyes. Anterior row faintly recurved; a. m. eyes about 0.7 diameter apart, 1.2 diameters from the larger side eyes. Median ocular quadrangle about as wide as long, wider behind than in front.

Chelicerae slightly reclined; stridulating file weak, but distinct; fang groove with five teeth in front, four behind. Sternum normal, separates hind coxae by a little less than a diameter. Palpus slender, several long spines on the tarsus. Legs moderately long and slender distally. Abdomen normal. Epigynum with a large, laterally broad and longitudinally narrow, clear sclerite; separated from anterior rim by a narrow, transverse, slit.

Male.—Structure: Carapace with thoracic part rather low; head broadly elevated, with a deep pit back of each p. s. eye; median groove

absent. Clypeus nearly vertical; height about 4.0 diameters of an a. s. eye. Eyes small, all in front and below cephalic lobe. Anterior eye row straight; a. m. eye about 0.8 diameter apart, 2.8 diameters from side eyes. Posterior row slightly recurved from above (procurved from in front) p. m. eye about 2.0 diameters apart, 2.0 diameters from side eye. Median ocular quadrangle about as wide as long, much wider behind than in front.

Chelicerae moderately weak; slightly reclined; fang groove with five teeth in front, four small teeth behind. Sternum broad, pointed behind; separates hind coxae by less than a diameter.

Palpus moderately large. Femur and patella normal. Tibia much enlarged, the ectal part formed into two rounded lobes, the mesal part extended as a long heavy process, hind ectad. Cymbium and paracymbium normal, moderately small. Embolus long, heavy, coiled, contorted at distal end; the tail-pieces small; tigulum distorted.

Measurements:

	♀ Mm.	♀ Ratio	♂ Mm.	♂ Ratio
Length	2.60	136	2.50	200
Cephalothorax:				
Length	1.10	100	1.25	100
Width	0 88	80	1.00	80
Tibia-patella:				
1.	1.10	100	1 20	96
4.	1.17	106	1.25	100

Type locality.—OREGON: Jackson Co., April 6, 1927, ♀, J. C. Chamberlin.

Other records.—CALIFORNIA: Atlerton, December, 1927, ♂, J. C. Chamberlin; Saratoga, March 25, 1928, ♂, J. C. Chamberlin; Riverton, July 15, 1935, ♀, W. Ivie; 48 m. No. Willets, March 4, 1938, ♂, 2 ♀♀, J. C. Chamberlin; Pacific Grove, August, 1937, 2 ♀, W. Ivie. OREGON· W. Corvallis, March 20, 1937, ♂ 4 ♀, J. C. Chamberlin.

Tortembolus monicus, new species

Fig. 139

Female.—Color: Carapace light yellowish brown, with distinct dusky markings of essentially the usual pattern. Chelicerae and endites light orange brown. Sternum and labium dark dusky brown. Legs and palpi light yellow. Abdomen blackish. Spinnerets pale yellow. Epigynum dusky, brownish and yellowish.

Structure: Size small, body moderately slender; legs short. Carapace normal; head raised slightly back of the eyes. Clypeus protruding; height about 2.0 diameter of an a. s. eye. Eye area occupies about 0.6 width of head. Eyes unequal, order of size being a. s., p. m., p. s., a. m.; the a. m. eyes less than half the diameter of the a. s. eyes. Posterior eye row slightly recurved; p. m. eyes 1.2 diameters apart, 0.8 diameter from side eyes. Anterior row slightly recurved; a. m. eyes about 0.4 diameter apart, 1.0 diameter from the side eyes. Median ocular area faintly wider than long, much wider behind than in front. Chelicerae slightly reclined; short. Sternum normal, obtuse behind; hind coxae separated by a little more than a diameter. Legs moderately short. Epigynum large; the principal sclerite is a broad, slender, inverted T.

Measurements:

	♀ Mm.	Ratio
Length	1.32	236
Cephalothorax:		
Length	0.56	100
Width	0.44	79
Tibia-patella:		
1	0.46	82
4	0.52	93

Type locality.—CALIFORNIA: Santa Monica, December 19, 1933, ♀.

Genus **Willibaldia** Keyserling, 1886

Die Spinnen Amerikas, 2(2): 123.

Generotype: *Willibaldia cavernicola* Keyserling.

Willibaldia (?) sodonta, new species

Fig. 146

Female.—Color: Carapace light brown; eyes on black spots. Chelicerae light brown. Endites light brownish orange, with pale tips. Sternum and labium light yellowish brown, very lightly shaded with dusky. Legs and palpi bright light brownish orange. Abdomen medium gray. Spinnerets light yellowish brown. Epigynum dusky brown.

Structure: Size medium large. Carapace normal in outline, head slightly humped back of the eyes; median groove absent. Clypeus nearly vertical; height about 0.3 diameter of a. s. eye. Eye area occupies about 0.7 width of head. Post eye row straight; p. m. eye about 1.3 diameters apart, 1.5 diameters from side eye. Anterior row straight; a. m. eye about 0.8 diameter apart, 1.7 diameters from side eye. Median ocular quadrangle with width in front equaling length, broader behind than in front.

Chelicerae reclined, moderately long; fang groove with three large teeth, close together in front, five small teeth behind. Endites moderately small. Sternum heart-shaped, median sized; hind coxae separated by a diameter. Palpi small. Legs rather large. Abdomen moderately small. Epigynum with a large transverse oval opening situated between an anterior and posterior ridge.

Measurements:

	♀ Mm.	Ratio
Length	2.35	214
Cephalothorax:		
Length	1.10	100
Width	0.87	80
Tibia-patella:		
1	1.20	109
4	1.26	115

Type locality.—WASHINGTON: White R. Camp, Rainier Park, July 6, 1938, ♀.

Genus **Wubana** Chamberlin, 1919

Ann. Ent. Soc. America, 12: 252.

Orthotype: *Wubana drassoides* (Emerton).

Wubana reminiscens, new species

Fig. 145

Female.—Color: Carapace light brown. Chelicerae light brown. Endites orange. Sternum and labium brown. Legs and palpi brownish yellow. Abdomen dark gray, with a large white spot above the spinnerets and with inconspicuous transverse lines and specks of light gray above. Spinnerets light yellowish. Epigynum light yellowish and reddish brown.

Structure: Carapace ovoid, narrowed in front; head slightly convex back of eyes. Height of clypeus about 2.2 diameters of a. m. eye. Eye area occupies about 0.6 width of head at posterior eye row. Posterior eye row straight; p. m. eyes 1.0 diameter apart, 0.6 diameter from side eyes. Anterior row faintly procurved; a. m. eyes about 0.4 diameter apart, same distance from larger side eyes. Median ocular quadrangle slightly wider than long, wider behind than in front. Chelicerae vertical; fang groove with two small teeth behind, none in front. Endites about as long as wide, convergent around labium. Labium wider than long. Sternum cordiform; separates hind coxae by about a diameter. Palpi small, spined, without terminal claw. Legs moderately long; stout basally, very slender distally; paired claws with a large tooth on under side. Abdomen normal; moderately high. Colulus distinct. Epigynum produced posteriorly into a single, straight, finger like projection.

Measurements:

	♀	
	Mm.	*Ratio*
Length	2.80	244
Cephalothorax:		
Length	1.15	100
Width	0.95	83
Tibia-patella:		
1	1.30	113
4	1.45	126

Type locality: WYOMING: Yellowstone Park, August 14, 1927, ♀, R. V. Chamberlin.

Genus **Zygottus**, new

A genus in some respects suggesting *Sisicottus* but the embolus of the male palpus short and not in a coil. The tibial apophysis of the male palpus arising at distal end and relatively long and slender and directed distad. The epigynum simple, presenting at caudal border a relatively small embayment.

Orthotype: *Zygottus corvallis* new species.

This genus as at present recognized embraces the two new species described below.

Zygottus corvallis, new species

Figs. 147–149

Male, female.—Color: Carapace light brown lightly marked with dusky. Chelicerae light brown. Endites light brown to dusky brown with pale tips. Sternum and labium dark dusky brown. Legs and palpi light yellowish brown, the distal tip of femora and base of tibiae usually somewhat paler than the rest. Abdomen medium to dark gray. Spinnerets light yellowish brown. Epigynum yellowish or brownish and dusky.

Structure: Carapace essentially normal, moderately short and broad; not modified in the male. Clypeus vertical; height about 2.8 diameters of a. s. eye. Eye area occupies about 0.7 width of head; a. m. eyes smaller than the others. Posterior eye row straight; p. m. eyes 0.9 diameter apart, 0.8 diameter from side eyes. Anterior row straight; a. m. eyes about 0.6 diameter apart, 0.8 diameter from the side eyes. Median ocular quadrangle about as long as wide, much wider behind than in front.

Chelicerae slightly reclined; stridulating file apparently absent; fang groove with four teeth in front, four small teeth behind. Sternum moderately large, convex, truncate behind; separates hind coxae by slightly more than a diameter. Palpus moderately small. Femur normal. Patella normal, short, barely longer than wide. Tibia slightly inflated, with a long, slender, curved process on the mesal side. Cymbium and paracymbium normal. Embolic division short; with a short, spatulate tail-piece, a somewhat enlarged middle section, and a very short embolus.

Measurements:

	♀ Mm.	♀ Ratio	♂ Mm.	♂ Ratio
Length	1.77	253	1.40	200
Cephalothorax:				
Length	0.70	100	0.70	100
Width	0.60	86	0.60	86
Tibia-patella:				
1	0.60	86	0.70	100
4	0.72	103	0 74	106

Type locality.—Washington: Denny Cr., Snoqualmie Pass, August 16, 1935, 5 ♀, W. Ivie.

Other records.—Oregon: 6 mi. W. Corvallis, May 9, 1936, 4 ♀, J. C. Chamberlin; Divide, April 28, 1937, 2 ♂ 6 ♀, J. C. Chamberlin.

Zygottus oregonus, new species

Figs. 150, 151

Female.—Color: Carapace yellowish brown, with dusky markings in the usual pattern; inter-ocular area mostly blackish. Chelicerae light brown. Sternum, labium and endites dusky brown. Legs and palpi light yellowish. Abdomen dark gray. Spinnerets brownish yellow. Epigynum light dusky over yellowish and light brownish.

Structure: Size small. Carapace normal. Height of clypeus about 2.5 diameters of an a. s. eye. Head slightly convex back of eyes. A. m.

eyes much smaller than the others; eye area occupies about 0.65 width of head. Posterior eye row straight; p. m. eyes 1.0 diameter apart, 0.9 diameter from side eyes. Anterior row slightly recurved; a. m. eyes 0.8 diameter apart, 1.0 diameter from side eyes. Median ocular quadrangle longer than wide, wider behind than in front.

Chelicerae slightly reclined; fang groove with five teeth in front, five small teeth behind. Sternum normal, posterior tip rounded; hind coxae separated by a little more than a diameter. Epigynum small; from ventral view consists of a small indentation in the posterior rim, in which a pair of small openings are concealed.

Measurements:

	♀ *Mm.*	*Ratio*
Length	1.50	224
Cephalothorax:		
Length	0.67	100
Width	0.54	81
Tibia-patella:		
1	0.57	85
4	0.63	94

Type locality.—OREGON: S. Denmark, April 27, 1938, ♀, J. C. Chamberlin.

BOOK NOTICES

SPIDERS OF CONNECTICUT, by BENJAMIN JULIAN KASTON. Connecticut State Geol. and Nat. Hist. Survey, Bull. 70, 874 pages, 6 text figures, 1 map, 142 plates. 1948.

Though the reviewer knows little about araneology, this appears to him to be a worthy companion to the various volumes on the insects of Connecticut and should prove as valuable as its predecessors in the study, not only of the New England fauna, but in that of other parts of temperate North America as well. The general treatment of external and internal anatomy, to which fifteen pages and the six text figures are devoted, together with the keys, descriptions, a glossary, and the apparently well-executed illustrations, should greatly facilitate identifications.

'he biology of the spiders is not neglected. Pages 27 to 44 are devoted to an account of the life history and habits, to parasites and other natural enemies, and to the economic aspects, including an account of arachnidism. In addition to this, a great deal of biological information is included in the separate accounts of the species, and twenty-nine plates are devoted to photographs showing such material as habitus studies, webs, spiderlings, and egg masses.

The manuscript was completed in 1941 and was delayed in publication, presumably by the war. As a result of this, some changes were made, with the result that some necessary inconsistencies occur. The absence of plates XXXII and LXVIII is perhaps the most noticeable of these.—M.T.J.

THE CHRYSOMELIDAE OR LEAF BEETLES OF GEORGIA, by P. W. FATTIG. Emory Univ. Museum Bull. 6. 47 pp. September 1, 1948.

This study lists 417 species and varieties of leaf beetles recorded from Georgia, with distributional and seasonal data. This is the sixth of a series, the previous numbers having dealt with the Mutillidae, Phyllophaga, the Asilidae, the Tabanidae, and the Cerambycidae.

Dr. Fattig's methods are not to be recommended to those compilers of lists who are anxious to break into print. His collections are made over considerable periods of time (twenty-one years in the present case), and the manuscripts are checked by specialists in the various groups so that the nomenclature becomes consistent within itself. Done in this way, a list of this type becomes a permanent contribution to the literature of entomology.—M.T.J.

MALARIA CONTROL ON IMPOUNDED WATER, by E. L. BISHOP, M. D. HOLLIS, C. I. MANSUR, and others. The United States Public Health Service and the Tennessee Valley Authority. xiv+422 pp., 215 figs., 43 tables. 1947.

This manual, which is intended to serve as a guide for engineers, medical officers and others concerned with the administration of control operations, attempts to present the basic principles and the modern practices of malaria control as applied to the impounded waters of flowing streams. Full consideration is given to the planning of malaria control programs for both proposed and existing empoundages, to primary antilarval measures and their application, to supplementary control measures such as mosquito-proofing and house-spraying, to the necessary facilities, field operations, and reports, and to the training of personelle. A general discussion of anopheline mosquitoes, their identification, biology, ecology, and relationship to malaria is included. The relationship of the control measures to wild life is discussed. Legal aspects, including summaries of the various state laws, are considered.

The purpose of the work is primarily utilitarian, and no claims are made except for the presentation of the best available information for practical purposes. As one would expect, references are few in number, and descriptions of technique

rather complete. Even the more technical parts of the work are easy to read. Most of the illustrations are quite clear; the color photographs are especially notable. The book presents a good appearance, with a good grade of paper and permanent binding.

The work as a whole appears quite well done. The reference to one malaria mosquito as *Anopheles freeborni* in one place and as *A. maculipennis freeborni* in another may be confusing to some. In addition to the use for which it was intended, the work will be of value to teachers and students of medical entomology.—M.T.J.

REVISTA ECUATORIANA DE HIGYENE Y MEDICINA TROPICAL.—An examination of volume 3, 1946, which was received for review, indicates that this journal publishes some work of interest to medical entomologists. There are two such papers in this volume: "Encuestas de malaria en el litoral Ecuatoriano" (Anonymous), pp. 124–148, 2 figures, 24 tables; and "Las moscas, como agentes vectores de enfermedades entéricas en Guayaquil," by Clodoveo Alcivar Z. and Francisco Campos R., pp. 3–14, 1+5 tables, 1 graph. Other articles, for example, "Limite fisico-quimicos de lo viviente," by José Crusellas Ventura, pp. 55–61, will interest some entomologists.—M.T.J.

HANDBOOK ON INSECT ENEMIES OF FLOWERS AND SHRUBS, by C. A. WEIGEL AND L. G. BAUMHOFER. U. S. D. A. Misc. Pub. No. 626. iii+115 pages, 170 figures. 1948. Price, 35 cents.

This handbook is designed for the use of the home gardener in recognizing the common insect and related pests he may encounter in the flower garden and in applying the proper remedies. The first part (pp. 2–18) deals with general insect pests, such as cutworms, grasshoppers, aphids, and sowbugs. The second part (pp. 18–94) treats insects attacking specific plants; only the chief pests are considered under each plant, but a cross index refers to others that are considered either in this or in the previous part. The remaining pages are devoted to a discussion of insecticides and their application, to dusting and spraying equipment, and to an index.

A great deal of information is contained in this booklet, and much of it will be of permanent value. The chief limitation, which is admitted in the preface, is that it was prepared prior to the development of the new insecticides; of these, only DDT is mentioned, and the discussion of it is placed in an appendix.—M.T.J.

INDEX TO VOLUME XLI

All new names are printed in *italics*

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MAILING DATES FOR 1948 ISSUE OF THE ANNALS

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